CRANFIELD UNIVERSITY

Onai Muvingi

Restructuring air transport to meet the needs of the Southern African Development Community

College of Aeronautics
Doctor of Philosophy

PhD
Academic Years: 2008 - 2012

Supervisors: Ian Stockman/ Dr Romano Pagliari
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This thesis is submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy

ABSTRACT

An efficient air transport system is an important part of social and economic development of Southern African Development Community (SADC). Efficient intra-SADC air service connections enhance regional integration, access to the global economy, international tourism and contribute towards the vision to establish the African Economic Community by 2034.

SADC, in July 1998, embarked on liberalisation of the regional civil aviation sector in order to enhance the efficiency of air transport services. In the United States of America and European Union, the liberalisation of air transport has transformed civil aviation networks. The fragmentation of air service connections on the intra-SADC network in the midst of the liberalisation process is symptomatic of a poor implementation strategy coupled with air transport market imperfections. The purpose of this thesis is to examine, understand and explain the factors that influence the disintegration of the intra-SADC air transport network .The aim is to identify how regional air transport services can be transformed to meet the social and economic demands of the region.

This research adopts network theory, as the conceptual framework of the investigation. Assuming a graph approaching maximal connection as the sought after state of affairs for SADC; this study benchmarked the post liberalisation network structure to the regional economic communities of ASEAN and MERCOSUR. The aim of the benchmarking is to identify the extend of the differences in air transport network in those two regions, resulting from the policies adopted and to establish how the SADC policies may be improved and implemented more efficiently. The findings of the study are that, in comparison to the two developing regions, SADC's liberalisation measures have failed. The study developed and evaluated an econometric model which analysed demand patterns on the intra-SADC passenger air transport network. Although low levels of passenger demand seem to characterise the majority of SADC city-pairs, the study identified nodes with sufficient demand to justify direct connections which would in turn reduce network fragmentation. This research also establishes that the absence of a realistic detailed roadmap, an ill-defined programme of action and inadequate resources contributed to the failure of SADC's liberalisation strategy. In its final sections, this study proposes an ideal demand-driven network configuration and offers specific recommendations to SADC member states for that network to be functional. The proposed network improves network connectivity from the current poor levels, where a connectivity measure of 15% suggests underdevelopment, to levels over 40%. The study however, acknowledges that air transport liberalisation does not necessarily guarantee equitable distribution of network efficiency in developing regions. There are communities that cannot sustain commercially viable air service connections without economic subvention, probably in the form of the Public Service Obligation (PSO) programme adopted in the EU.

Keywords: Network analysis, graph theory, demand analysis, benchmarking, gravity model

DEDICATION

This study is dedicated to the three most important men in my life; my husband Koga and my sons Phillip and Nyasha. These three men endured the extended absence from home of a wife and a mother to allow me to follow the dream of acquiring more knowledge on air transport and contribute knowledge regarding the reformation of SADC's airline industry.

This research was not only undertaken primarily to contribute original knowledge regarding air transport liberalisation in Southern Africa, but also for personal further studies in the United Kingdom. A keen interest in the role of the aviation industry in national and regional economic development motivated the conception of this research. My husband served not only as the source of encouragement but also as the logistics and supplies manager throughout the study.

To Koga, the seed you planted has been able to bear fruits. I will forever be grateful for the opportunity you gave me to pursue this dream. Without your consent and support this study would have remained a pipe dream. I am privileged to have you for a husband and best friend. To my sons Phillip and Nyasha I undertake to dedicate more time to you now that the search for more knowledge is over.

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This study would not have been possible without good health from God and the assistance of many people some who are not mentioned here.

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My research was made an exciting experience by a number of people within the academic community. Constructive criticism from my research degree committee that was chaired by Dr Sarah Fletcher helped in sharpening my research skills. I appreciate the assistance and guidance I got from Dr George Williams, Dr Keith Mason, Dr Chikage Miyoshi, Dr Lei Zheng, Andy Foster, Dr Nigel Dennis and Professor Vimbai Kwashirai.

Understanding the dynamics of African aviation and getting valuable insights into the challenges SADC faces was critical to the successful completion of this study. A few individuals and organisations stand out for making this possible. I would like to thank Ato Girma Wake (the then CEO for Ethiopian airlines), Dr Elijah Chingosho (AFRAA Secretary General), Jonathan Majakwara (the Programme Officer responsible for air transport in SADC) and Carlos van-Hafe for allowing my curiosity and sometimes naïve questions to interrupt their busy schedules. Dr Charles Schlumberger at the World Bank and Embraer provided a platform that greatly aided data gathering for my study. To Professor Graham Braithwaite, thank you for affording me the privilege to use the Department of Air Transport's budget to attend conferences that added depth to my study.

The PhD research journey is a lonely and strenuous affair that requires moral support from friends and family. Without support from Ayudh Nakaprasit, a fellow PhD student, I could have easily contributed towards PhD dropout

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Last but not least are those people that have cheered me on even at those moments I felt the going was getting tough. To my Mom and young brother Edison, Innocent Tasara and Karikoga Chihota, thank you for your support.

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LIST OF ACRONMYS

AASA	Airlines Association of Southern Africa
ACI	Airport Council International
AEC	African Economic Community
AFCAC	African Aviation Commission
AFRAA	African Airlines Association
AOC	Air Operator's Certificate
ASEAN	Association of East Asian Nations
ATAP	ASEAN Transport Action Plan
ATAG	Air Transport Action Group
BASA	Bilateral Air Service Agreements
CARICOM	Caribbean Community
DRC	Democratic Republic of Congo
EU	European Union
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GNI	Gross National Income
HDI	Human Development Index
HHI	Herfindahl-Hirschman Index
HIPC	Highly Indebted Poor Country
ICAO	International Civil Aviation Organisation
IATA	International Air Transport Association
IRRN	Inter Regional Railway Network
MERCOSUR	Mercado Común del Sur (Common Market of the South)
MIDT	Marketing Information Data Transfer database
OAG	Official Airline Guide
O/D	Origin and Destination
PSI	Political Stability Index
PSO	Public Service Obligation

RETOSA	Regional Tourism Organization of Southern Africa
RTRN	Regional Trunk Road Network
SADC	Southern African Development Community
SAP	Structural Adjustment Programme
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNWTO	United Nations World Tourism Organisation
U.S.	United States of America
VIF	Variance Inflation Factor
YD	Yamoussoukro Decision

AIRPORT CODES

SADC

DAR	Dar es Salaam, Tanzania
GBE	Gaborone, Botswana
FIH	Kinshasa, DRC
HRE	Harare, Zimbabwe
JNB	Johannesburg, South Africa
MSU	Maseru, Lesotho
MTS	Manzini, Swaziland
MPM	Maputo, Mozambique
MRU	Mauritius, Mauritius
SEZ	Seychelles
TNR	Antananarivo, Madagascar
WDH	Windhoek, Namibia
LAD	Luanda, Angola
LLW	Lilongwe, Malawi
LUN	Lusaka, Zambia

ASEAN

BKK	Bangkok, Thailand
BWN	Bandar Seri Begawan, Brunei
CGK	Jakarta, Indonesia
KUL	Kuala Lumpur, Malaysia
MNL	Manila, Philippines
PNH	Phnom Penh, Cambodia
RGN	Yangon, Myanmar
SGN	Ho Chi Minh City, Vietnam
SIN	Singapore (Changi)

MERCOSUR

VTE	Vientiane, Laos
ASU	Asuncion, Paraguay
BOG	Bogota, Colombia
CCS	Caracas, Venezuela
EZE	Buenos Aires (Pistarini), BA, Argentina
GRU	Sao Paulo, SP, Brazil
LIM	Lima, Peru
MVD	Montevideo, Uruguay
SCL	Santiago, Chile
UIO	Quito, Ecuador
VVI	Santa Cruz, Bolivia

1 Chapter One: Background of the study

1.1 Introduction

The importance of an efficient, reliable, integrated and demand-driven regional air transport network in the Southern African Development Community (SADC) is irrefutable. Air Transport Action Group (ATAG, 2008) argues that good air transport links are vital to the social and economic progress of any region. Consisting of airports and the routes that connect them, regional air transport networks are human-made infrastructures that are designed for the distribution of passengers, cargo and mail (Zhang et al, 2010; Janic, 2007). The decision to restructure the intra-SADC civil aviation network as part of the regional economic and social integration strategy demonstrates SADC's conviction that a well-designed air transport network can expedite the achievement of socio-economic development goals.

1.1.1 Importance of regional air service connections in SADC

The need for transportation stems from the interaction among social and economic activities dispersed in space (Kanafani, 1983). Economic theory describes demand for air transport as derived demand arising out of economic, social or personal activities at desired destinations (Bell and Lida 1997, Button and Stough, 2000). People travel not because they enjoy movement. The United Nations World Tourism Organisation (UNWTO, 2011a) statistics reveal that the reasons for travel are many. They cover social (visiting friends and relatives, health, education, holidays and sports) and economic (business and employment). Goods are moved from place to place for several reasons, chief among them the economic necessity of production and consumption and the pursuit of economic advantage and gain (Kanafani, 1983).

Owen (1987) contends that "many factors contribute to economic and social progress, but mobility is especially important because the ingredients of a satisfactory life, from food and health to education and employment, are generally available only if there is adequate means of moving people, goods,

and ideas". Because of its potential to bridge gaps between people and places (Bowen, 2002; Daley, 2009), air transport has been described by Oxford Economic Forecasting (2006) as the "engine" of economic growth and social development. Air transport literature describes civil aviation infrastructure as a vital component of economic interchange that exerts enormous leverage on the economic perspective of an entire region in terms of economic development, social evolution and community welfare (Goedeking, 2010; Grubesic, Matisziw and Zook, 2008; Guimera, Moosa, Turtschi and Amaral, 2005; Ivy, 1995; Paleari, Redondi and Malighetti, 2010).

Formed in Windhoek, Namibia on 17 August 1992, SADC is a regional economic group of 15 developing countries that are structurally diverse and at varying stages of economic development (Nevin, 2005). One of the key motivations for the creation of SADC was collaboration to expand markets. As a result there have been concerted efforts to develop policies aimed at "progressive elimination of obstacles to the free movement of capital and labour, goods and services, and people" across national borders. Because of the vital importance of trade and tourism to regional economic growth, SADC prioritised elimination of such obstacles. As a result, on 24 August 1996, SADC signed a protocol on trade, in which governments agreed to liberalise intra-regional trade and pave the way for the creation of a common market by 2015(SADC, 2008). The year 1998 ushered in a tourism protocol in which member states agreed to ease inter-country travel and visa restrictions in order to stimulate travel and tourism flows.

A recent authoritative World Bank study (2011a) evaluated the extent to which SADC economies have integrated into the global trading system. Focusing on regional trade policy reform and trends in intra-SADC and extra-SADC trade flows over the period 1990 to 2008; the study establishes that intra-regional trade flows have increased and trade has risen as a share of GDP. The study however observes that SADC's potential is hamstrung by high barriers to trade particularly transportation because of the region's topography. They conclude that although the trade performance of SADC is not lagging behind other

developing regions, other regions continue to find innovative ways to eliminate obstacles to trade. They suggest SADC has to keep pace by finding solutions to transportation systems that lessen barriers to trade. The geographical location of SADC countries as shown in Figure 1-1 below renders air transport the mode of choice for improvements to the intra-SADC transportation system.

Source: Created using Google Great Circle Mapper (copyright © Karl L. Swartz) and based on http://www.sadc.int/english/about-sadc/ accessed 21 March 2012

Figure 1-1 SADC member states as of April 2011

Twelve SADC countries are located on the African continent and three (Madagascar, Mauritius and Seychelles) are islands. The only practicable mode of travel between the continental and island countries is by air. Commercial intra-SADC passenger travel by sea is yet to be developed. Of the states located on the mainland, 7 countries (Botswana, Democratic Republic of Congo (DRC), Lesotho, Malawi, Swaziland, Zambia and Zimbabwe) are landlocked. The mainland does not have any navigable intra-SADC shipping waterways or canals. Although there are concerted efforts to improve the intra-SADC surface transport links (road and rail), the rapid movement of goods, services and people between and amongst the landlocked countries is constrained by long distances (Schlumberger; 2010). Another advantage for air transport is that unlike rail and road links that have fixed infrastructure, air service connections between airports, with government approval, are readily added or deleted (Ivy, 1995).

One most commonly used single measure of a country's overall economic activity is the Gross Domestic Product (GDP) (World Bank, 2012). GDP represents the total value at constant prices of the final goods and services produced within a country during a specified time period, such as one year (International Monetary Fund, 2012). The International Monetary Fund (2012) predicts positive growth in real GDP for SADC countries over the period 2012 to 2017 (see Appendix A). In addition, 6 states (Angola, DRC, Madagascar, Mozambique, Tanzania and Zambia) are expected to experience growth rates that are higher than the projected world average of 4.7 per cent.

Transport economics theory posits that as economies grow so does demand for air transport (Vasigh et al, 2008; Mason and Alamdari, 2007). The UNWTO (2011b) predicts that international tourism arrivals in Africa will grow by 3.3 per cent per year over the period 2010 to 2030. They also predict that over the same period, air transport will capture more market share from other modes of travel used by tourists.

Describing air travel as a growth market, Airbus (2011) and Boeing (2011) predict air traffic growth within Africa over the period 2011-2030. They both

anticipate that the traffic will grow at a rate higher than the projected world average GDP growth rates of 4.4 per cent. The International Civil Aviation Organisation (ICAO, 2011) is of the view that as economic conditions improve, African airlines are likely to register higher traffic growth levels. They predict growth rates of between 8 and 8.3 per cent for the years 2012 and 2013 respectively. An efficient intra-SADC air transport network is vital as it serves to deliver economic and social benefits by connecting businesses to markets (both regional and international) and by enabling SADC nationals and visitors to the region to reach valued destinations (for recreational and social activities) friends, and relatives.

1.1.2 Link between intra-SADC network and the global economy

The ability of a region to compete in the global market for international trade, foreign direct investment (FDI), and international tourists is determined or undermined by its air transport network (Bowen, 2002; Daley, 2009; Oxford Economic Forecasting, 2006). As the only global mode of transport that "serves to increase trade, attract investments, grow a tourism industry, and weave together a modern society", (Goldstein, 2002), air transport in developing countries helps stimulate significant economic activity by ensuring closer integration with the world economy, creating easier access to multinational corporations and attracting more tourists (Hilling, 1996; Bowen, 2000). Studies on international firms' new investment location decisions ascertained a link between good regional air transport links and new investment flows (Bowen, 2000; Wittmer and Laesser, 2009; Oxford Economic Forecasting, 2006). Keeling (1995) is of the view that air transport is "the preferred mode of intercity movement for the transnational capitalist class, migrants, tourists and high-value goods.

Endowed with abundant natural resources and a large population (273 million inhabitants as of 2010) SADC presents itself as a potential attractive investment destination. Natural resources particularly in the extractive sector (mining and oil) have also drawn foreign investment and trade flows to SADC. According to

the International Monetary Fund (2012), natural resources have attracted sizeable portfolio inflows from international investors in 8 SADC states (Angola, DRC, Botswana, Madagascar, Mauritius, South Africa, Zambia and Zimbabwe). The large and growing populations, together with improving conditions of living creates market opportunities for foreign investment opportunities for the travel and communication sectors.

A number of SADC countries are key players in the global fresh flowers export market. According to Belwal and Chala (2008), 6 SADC countries (Malawi, Namibia, South Africa, Tanzania, Zambia and Zimbabwe) have a well-established presence in this fragile goods market. Muhammad et al (2010) observed that Tanzania, Zambia and Zimbabwe were notable exporters of fresh cut flowers to the European Union (EU) in the year 2008. The World Bank (2012) study on trade establishes that these countries have increasingly diversified their exports away from the traditional markets in Europe to other emerging markets and the intra-regional market. Flowers are a fragile commodity that needs to reach the market in good condition and at the right time (Belwal and Chala, 2008). Speed and on-time delivery are of essence in this sector. This makes air transport not only essential but also the best alternative.

Integral to the emerging market of South Africa, the strongest economy on the African continent (in terms of both GDP and Gross National Income[1] (GNI), SADC possesses substantial potential for a vibrant and strong regional economy. FDI flows to South Africa have multiplier effects on the region as the new investors expand their markets into other SADC countries. In the year 2008 South Africa attracted annual FDI flows of US$17 billion. South Africa is also a major international tourism destination and this has beneficial spill-over effects on other SADC states. Of the 49.6 international tourism arrivals in Africa in 2010, 43 per cent were destined for SADC (UNTWO, 2011a).

[1] The World Bank (2012) defines GNI as the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad.

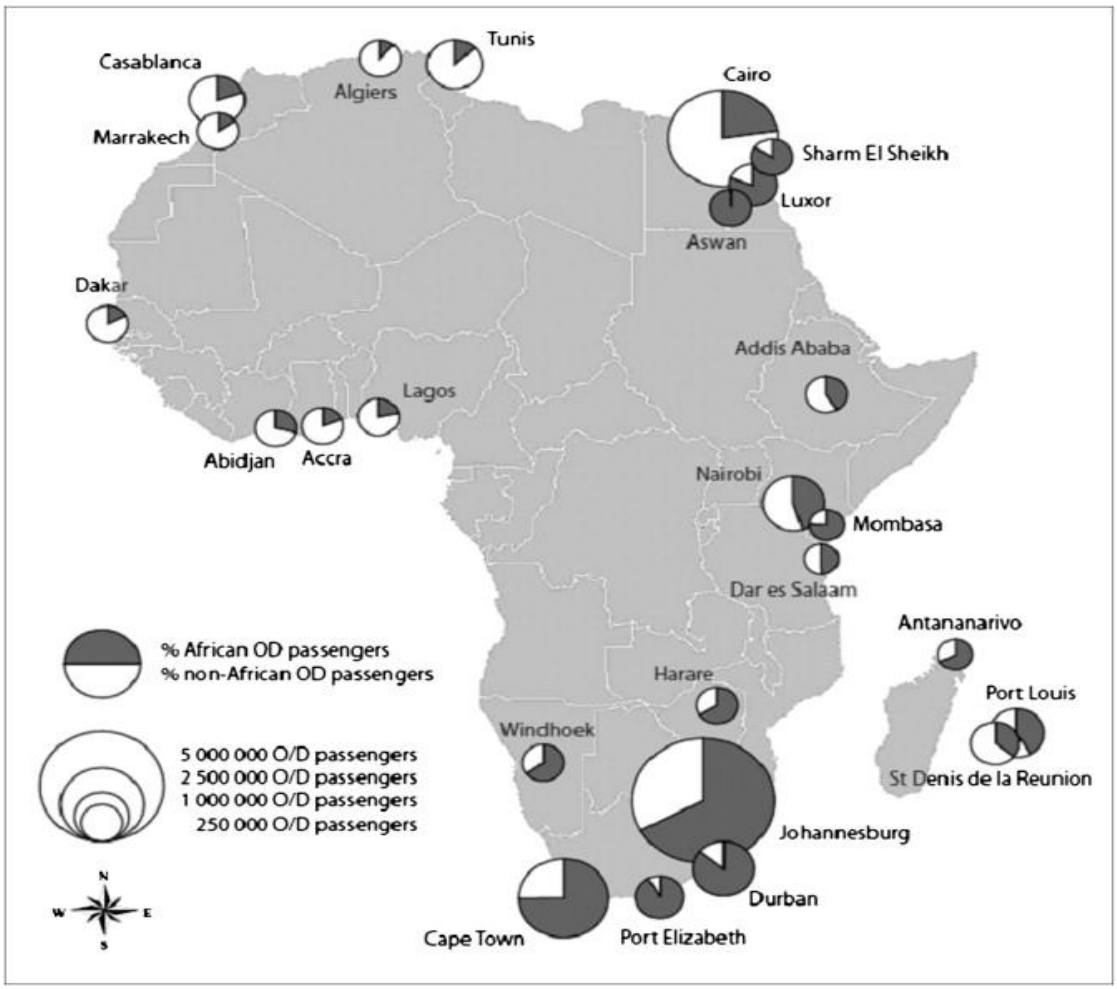
Although international traffic flows are able to rely on international mega-carriers for travel to SADC, regional and continental civil regulations bar these airlines from serving the intra-SADC market. Non-African international airlines are only allowed access to a few designated international airports. The intra-SADC air travel market is protected from competition from non-Africa airlines so travellers have to rely on SADC carriers for their intra-SADC travel needs. Apart from international visitors, SADC countries also have a sizeable immigrant community that rely on regional air transport links to travel back home to visit friends and relatives. A well-designed air transport network that facilitates air travel within, between, and beyond all SADC member states is pivotal to trade, foreign direct investment and the growth of international tourism.

1.1.3 Intra-SADC network and the African Economic Community

SADC exists within a wider African community. The formation of the region came shortly after the Organisation of African Unity (now the African Union) had agreed to establish the African Economic Community (AEC). The Treaty establishing the AEC was signed on 3 June 1991 in Abuja, Nigeria. The AEC was a culmination of various attempts at developing a continental framework for economic integration, which can be traced back to the Kinshasa Declaration of 1976. The purpose of the AEC, established since May 1994, is the integration of 54 African economies for economic, social and cultural development (African Union, 2011). The African Union's ideal vision, though admittedly ambitious, is the gradual transition, through a six-stage process to an African Common Market by the year 2025. African governments agreed to use regional economic communities as building blocks for the AEC vision.

The treaty that created the AEC recognises the importance of air transport for close economic and social ties within the African continent. Article 61 encourages regional economic communities to promote integration of air transport in AEC and to coordinate flight schedules. SADC has a mandate to ensure an efficient intra-SADC air transport network that facilitates air travel connectivity within the AEC. A recent study by Otiso et al (2011) used airline

connections to assess the globalisation of African cities and concluded that Africa is still not well integrated into the global economy. This is because many African cities have poor airline interconnectivity among themselves as well as internationally. The study however notes that some cities have become important cogs in Africa's air transport network and that their airline connectivity and rank have grown significantly during the period 2001 and 2009. Using actual origin and destination (O/D)-passenger flows obtained from the marketing information data transfer (MIDT) dataset, the study identified 25 cities, presented in Figure 1-2 below; that have become important cogs in the AEC's air transport network.



Source: Adapted from Otiso et al, 2011

Figure 1-2 The 25 cities that are important in AEC air transport network in terms of O/D passengers for the period 2001 to 2009

In air transport the origin of a passenger is the point at which they board an aircraft and their destination is the point at which they disembark from that aircraft. Of the 25 cities Otiso et al (2011) identify as important cogs in Africa's air transport network, 9 are in SADC; with Johannesburg the busiest city on the continent.

As one of the 8 regional economic communities of the African Union, the social and economic progress of SADC is inextricably linked to the achievement of the goals of the AEC (preamble to SADC Treaty, 1992). The Otiso et al (2011) study notes that the intra-SADC network caters for more passengers with an African O/D than the rest of the continent. SADC's remit for ensuring a well-developed regional air transport network goes beyond the immediate needs of SADC to those of the AEC and globalisation more generally.

1.1.4 Importance of a well-designed intra-SADC air transport network

Moores (2010) argues that regional air transport routes are fundamental to Africa's economic growth. Oxford Economic Forecasting (2003) argues that civil aviation can be used consciously to help attain sustainable national and regional development in Africa. Despite the contention that transport is an essential but not sufficient condition for economic growth and development (Banister and Berechman 2001; Graham, 1998), there is no dispute that the shape and structure of a transportation system affects the performance of the network and the characteristics of a region's economy (Button and Hensher 2001; Xie and Levinson, 2007; Blumenfeld-Lieberthal, 2009).

Transport network structures shape the flow of capital, labour, passengers, cargo and information on a transportation system. This in turn determines regional economic activity and social integration. The International Air Transport Association (IATA) advises that a well-designed air transport network is an indispensable infrastructure asset that is important for economic development and growth as it "widens markets, boosts productivity, stimulates GDP growth,

fosters greater competitiveness, encourages greater investment and drives trade and tourism."

Important studies on transportation networks observe that higher levels of connectivity and accessibility correspond with higher levels of regional economic activity and economic growth (Rodrigue, Comtois and Slack, 2009; Sokol, 2009). They further argue that socio-economic development tends to occur in accessible regions. Owen (1987) argues that a strong correlation exists between good transport linkages and urban integration at national, regional and global levels. Sokol (2009) suggests higher levels of regional connectivity and accessibility enhance regional competitiveness and foster regional development.

SADC has aspirations to ensure harmonious, balanced and equitable regional socio-economic development. The ideal integrated intra-SADC air transport network that would facilitate the achievement of this goal is one that would make it possible to access landlocked countries and ensure reachability of islands. It would eliminate impediments in trade and tourism travel. Expeditious export of fresh cut flowers from countries like Zimbabwe, Zambia and Malawi to distant regional markets like Mauritius and DRC would be possible. International traffic arriving at any SADC airport would be assured of flight connections to destinations of their choices in any other SADC member state.

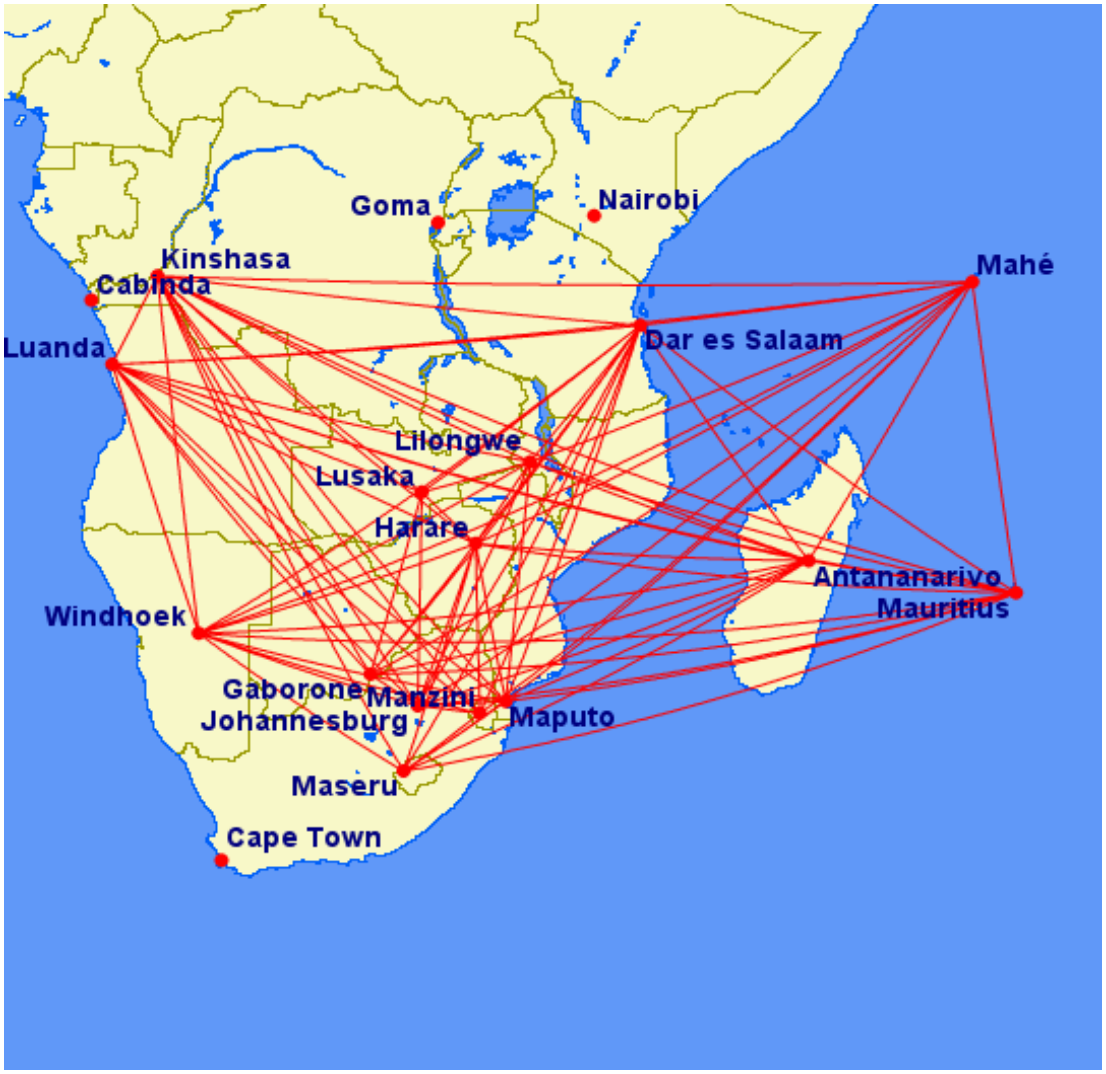
The word "ideal" as an adjective, has three possible meanings according to the Bloomsbury Concise Dictionary (2005): -

a) Serving as the best or most perfect example
b) Perfect but existing only in imagination and
c) Excellent or perfectly suitable

Using the first definition, an ideal network would be one whose level of quality is the expected norm or model and against which actual achievements of regional integration can be judged. The second explanation suggests an integrated network that conceptually exists only in the mind. The third

description implies an optimal network or one that is best suited to the regions' circumstances.

The "ideal network" that this study makes reference to, relate to both the first and third explanation. The model of excellence is used to describe the network having the typical characteristics of an integrated network. The air transport network that would be considered as the perfect example of excellence would be one that connects every SADC country to all other countries within the region as is shown in Figure 1-3.



Source: constructed using Google Great Circle Mapper (copyright © Karl L. Swartz) and the busiest airports in each of the SADC member states in 2010 as per Airport Council International (ACI, 2011) statistics

Figure 1-3 Perfect example of an integrated intra-SADC civil aviation network structure

In practice, the design and delivery of such an ideal network takes generations. The shape and structure of a regional air transport network is not just a function of geography and space; economic concerns and political choices form part of the equation (Blumenfeld-Lieberthal, 2009). The decision on which city-pairs are connected is a function of what is economically sustainable, technologically appropriate, geographically practicable, and politically viable. Political considerations have tended to eclipse economic concerns on the intra-SADC network. The network that is best suited to the region's circumstances is what this study seeks defines as the ideal.

The Convention on International Civil Aviation (Chicago Convention, 1944) places the responsibility for the design of efficient air transport systems solely on governments. It gives states "complete and exclusive sovereignty over the airspace above their territory. The Chicago Convention permits governments the flexibility to allow or refuse operation of commercial aviation over, into and out of their countries. The manner in which SADC governments exercise this right to "complete and exclusive sovereignty" determine the shape, efficiency and performance of the intra-SADC scheduled air transport network.

Historically regional air service connections in SADC have been governed by Bilateral Air Service Agreements (BASAs) between member states. These agreements have tended to include high barriers to entry on the intra-SADC air transport market. Through BASAs governments restricted access to airports, ownership in airlines, airline designation, traffic rights, flight frequency, capacity, fares and competition.

In the early 1980s, civil aviation was considered a strategic industry for defence and security reasons and not every airport could be accessed by international traffic. Most of the airlines serving the regional network were also state-owned enterprises. The network was characterised by single designation of airlines from each state. As a result all city-pairs were either monopoly or duopoly markets served by state controlled airlines. Of the possible 9 commercial traffic rights (also known as freedoms of the air) that governments can allow SADC airlines to enjoy, SADC carriers could only access the first four. These

commercial rights that are illustrated in Figure 1-4 are critical to the design of efficient networks. In addition airlines could not mount flights, offer capacity and charge economic fares as they wished. The intra-SADC market was also sheltered from competition. The net effect was that demand for air travel was suppressed, airlines did not have the flexibility to design demand driven route networks and fares (per air passenger kilometre travelled) were generally high when compared to other developing regions (Schlumberger, 2010; Chingosho, 2005).

Freedoms of the Air relate to the right or privilege, in respect of scheduled international air services, granted by one State to another State or States.

This illustration uses the BASAs governing the activities of airlines based in South Africa

1st : the right to overfly Botswana, Namibia and Angola enroute to Kinshasa without landing
2nd : the privilege to land in Botswana, Namibia or Angola for non-traffic purposes (technical reasons including refuelling).
3rd : the right to drop commercial traffic from South Africa that is destined for Madagascar
4th : the freedom to enplane commercial traffic from Madagascar that is destined for South Africa.
5th : the right to enplane and deplane in Madagascar and Seychelles, commercial traffic coming from and destined for Seychelles and Madagascar respectively. This right is exercised as an extension to a flight originating /destined for South Africa.
6th : the right to transport commercial traffic between Namibia and Botswana via Johannesburg (it is basically a combination of third and fourth freedom traffic rights)
7th : the right to carry commercial traffic between DRC and Tanzania with no requirement for the flight to have originated or destined for South Africa.
8th : the right to transport cabotage (Zimbabwean) traffic between Harare and Victoria Falls on a route originating/destined for South Africa.
9th : the right to transport "pure" cabotage (DRC traffic) between Kinshasa and Lubumbashi on a stand alone route. There is no requirement for the route to have originated or be destined for South Africa.

Source: Created using Google Circle Mapper (copyright © Karl L. Swartz) and ICAO Manual on the Regulation of International Air Transport (Doc 9626, Part 4)

Figure 1-4 Illustration for freedoms of the air on the intra-SADC network

SADC states made a strategic decision to restructure the intra-SADC air transport network on 24 August 1996 in Maseru, Lesotho. SADC countries committed themselves to adopt air transport liberalisation policy as the conduit for creating good and efficient regional air service links. In pursuit of this strategic agenda, SADC ratified two legally binding air transport liberalisation initiatives; the SADC Protocol on Transport, Communications and Meteorology (SADC protocol on TCM, 1996) and Yamoussoukro Decision (YD, 2000) on the liberalisation of access to air transport markets in Africa.

The goal for the SADC protocol on TCM, for the civil aviation sector, is the provision of safe, reliable and efficient scheduled regional air service connections. SADC's ambition is to construct what the Regional Indicative Strategic Development Plan describes as "seamless, integrated, efficient, safe, cost- effective and responsive transport systems" (SADC, 2012).The protocol was ratified and became law in all SADC states effective from July 1998.

Described by Doganis (2006) as far reaching and by the United Nations Economic Commission for Africa (UNECA) as the most radical step in African civil aviation, the YD is a home grown continental initiative whose vision is the establishment of a single aviation market for Africa. According to UNECA (2003) the key goal for air transport liberalisation on the African continent is the need to nurture "a conducive environment for the development and provision of safe, reliable and affordable air transport services necessary for the free movement of persons, goods and services in Africa." Heads of states and government in Africa adopted the YD in July 2000 and its provisions became legally binding in all member states from 12 August 2002. The YD incorporated and took precedence over any incompatible provisions in the SADC Protocol on TCM.

1.1.5 Air transport liberalisation and network design

The origins of air transport liberalisation is attributed to the 1978 United States of America (U.S.) Deregulation Act which gathered momentum in the 1980's and has been adopted by various states in many parts of the world (Golich, 1990; Janic, 1997). The positive results that the U.S. air transportation system

had recorded from the post-1978 airline deregulation era triggered the wave of liberalisation agreements worldwide (Chou, 1993). The European Union (EU) followed suit starting with the first phase in December 1987(Button, 1990; Williams, 2002). Air transport liberalisation was defined by privatisation, deregulation and free competition in the aviation industry with the state as arbiter or referee.

The number of regional air transport liberalisation agreements that have been initiated and deposited with the ICAO (2009) bears testimony to the importance policy makers attach to this method as a technique for improving airline networks. The implementation of air transport reforms and the resultant impact on the geography of air transport networks has attracted many studies in various disciplines. Although results differ, empirical evidence from well-known studies (Paleari et al, 2010; Fan, 2006; Bowen, 2000; Warnock-Smith and Morrell, 2008; Williams, 2000) suggest that the structures of many aviation networks have undergone fundamental changes due to liberalisation.

Paleari et al (2010) notes that liberalisation has increased the size of several aviation areas with the biggest gains realised in the U.S. domestic market and the EU. Fan (2006) attributes the improved intra-European air travel connections to air transport restructuring policies. Bowen (2000) establishes a positive link between aviation reforms and the improvements in the air transport network and the resultant rapid economic expansion of the Association of East Asian Nations (ASEAN). Warnock-Smith and Morrell (2008) establish a positive statistical relationship between air policy reforms and traffic growth in the Caribbean Community (CARICOM).

There are also observations that liberalisation efforts in many parts of the world remain an incomplete process and in some cases the processes remain uneven (Bowen, 2002; Morrell, 2007; Paleari et al, 2010; Schlumberger, 2010). There is however no doubt that in a liberalized environment, the power to design efficient air transport networks shifts from governments to market forces and the airline industry (Malighetti, Paleari and Redondi, 2007).

The intra-SADC air transport network has been undergoing restructuring since July 1998. Restructuring in this study refers to the reform of policies and institutions involved in the provision of regional air service connections. This thesis evaluates the extent of regional integration achieved by the SADC's air transport network as a result of adopting the liberalisation strategy. Using direct flight connections linking the key cities in each SADC member state, this thesis evaluates the extent of air transport integration achieved, as at April 2011. It also explores the challenges faced and the prospects for improvement.

This thesis does not attempt or claim to quantify the cost and benefits of air transport liberalisation to SADC. Well known IATA commissioned studies particularly those carried out by InterVISTAS, have developed econometric models by which they have documented cost and benefits accruing from air transport liberalisation. It is important to note however that air liberalisation in SADC is taking place in a wider policy context and against a backdrop of difficulties encountered with the implementation of Structural Adjustment Programmes (SAPs) during the 1980s. SAPs are common in SADC as they are policy prescriptions by the International Monetary Fund and the World Bank on those SADC governments that need credit rating, access to loans and balance of payments support. Free trade underlined by the three principles of privatisation, deregulation and competition policies is a key element of structural adjustment programmes worldwide. Air transport liberalisation entails the same fundamental policy and institutional shifts; changes that are generally similar to economic liberalisation at the national level. This thesis unravels how experiences with economic structural reforms may have impacted the liberalisation and shaping of SADC's air transport network.

Inherent in liberalisation strategies is the conflict between economic and social welfare objectives. Airlines are in business to make money and in a liberalised environment without state subsidies they can only serve those intra-SADC markets that are profitable (1Time Holdings, 2012). In a number of SADC countries, there are communities where even though air service is the only feasible mode of transport, they cannot afford to sustain profitable airline

operations because of the size of their market. Governments on the other hand have an obligation to ensure that every SADC national has equal access to air transport. Whilst there is consensus that international air transport can and must pay for its way, there exist, in SADC some regional air service connections that might not be commercially profitable but economically and socially important. Such is the case with countries like Angola and Mozambique with huge foreign direct investment potential but underdeveloped regional surface transport links that impede intra-regional trade potential. In addition certain regional air service connections, particularly those serving poor countries are vital for access to critical services such as health care and food aid. In such situations, air service connections can best be described as a public good where there is need for governments to subsidise such services with either direct subsidies from the national budget to airlines or indirectly in the form of special concessions on aeronautical charges. Whilst such economic subventions ensure sustainable operations and profitability for SADC airlines serving such routes, they also serve as channels for income redistribution and equity in poor regions.

However in a liberalised environment, subsidies to airlines violate free competition rules and for some governments it might even be in contravention of the International Monetary Fund's lending conditions. It is for this reason that contradictions exist with regard to the advantages of air transport liberalisation strategy to developing and aid recipient nations. Rodrik (1999) cautions that the costs of air transport liberalisation falls on poor people, poor regions and poor countries. Woodward (1996) views liberalisation in poor countries as a case of more pain and little gain as he argues they "confront the negative consequences but capture few benefits." The intention of this thesis is not to debate the merits of air transport liberalisation in poor regions but rather to assess the impact of restructuring on air service connections in such regions.

1.2 Conclusion

The geographical characteristics of SADC and its remoteness from the key global markets motivated policy makers to embark on fundamental regional civil aviation reforms. The intention was to create an environment that nurtures the

“development and provision of safe, reliable and affordable air transport services necessary for the free movement of persons, goods and services in SADC and AEC.” Although liberalisation policy is fraught with uncertainties, reforms on the intra-SADC network are premised on net welfare gains from regional economic and social integration. The thesis makes use of the network structure that has emerged from the liberalisation strategy over the period July 1998 and April 2011 as important evidence for exploring problems and prospects of civil aviation reforms in SADC.

1.3 Thesis structure

The organisation of this thesis is outlined in Figure 1-5

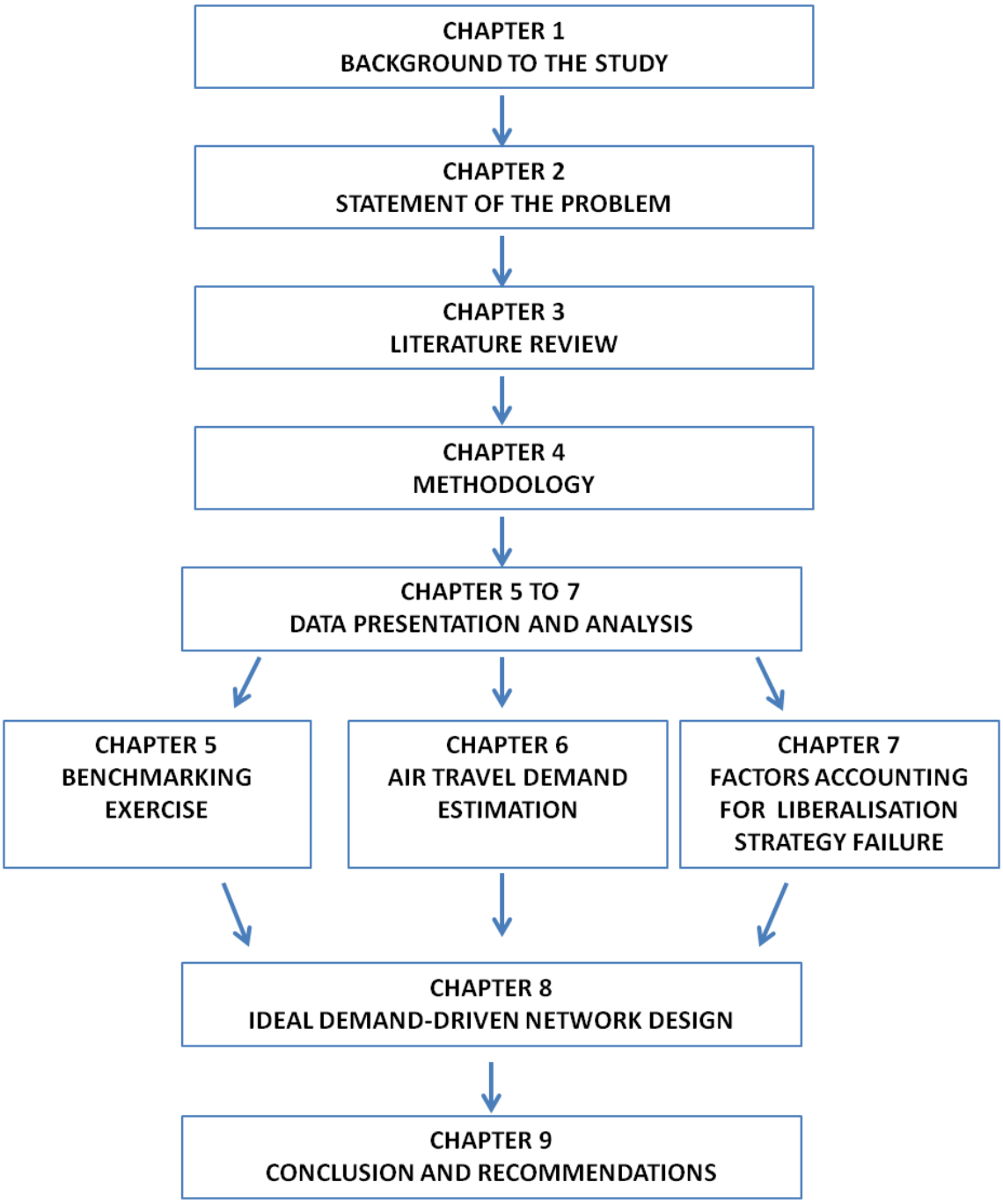


Figure 1-5 Thesis structure

2 Chapter Two: Statement of the problem

2.1 Introduction

Air transport liberalisation had a positive and transformative effect on air transport networks in the U.S., EU, ASEAN and Mercado Común del Sur MERCOSUR (also known as the Common Market of the South). Taking a cue from these examples SADC policy makers attach great importance to efficient air transport links as an enabler of regional integration and access to the global economy. Air transport liberalisation is a strategy that seeks to replace government interventionist policies in the market place with market-oriented principles in order to improve efficiency in the provision of air transport services (Chingosho, 2005; Williams, 2002). Air transport liberalisation removes market entry barriers and encourages competition (Schlumberger, 2010). The role of national governments is limited to ensuring fair competition, safety, and security in the provision of air services. The expectations are that regional air transportation networks become efficient as market forces are left to identify underserved and neglected markets. This chapter explores the drivers for air transport demand and the driving force behind the adoption of air transport liberalisation as the strategy for restructuring SADC's regional civil aviation. The chapter examine the key features of the liberalisation strategy that SADC adopted and the characteristics of efficient air transport networks. The network structure that has emerged from the restructuring efforts covering the period July 1998 to April 2011 is assessed. The research aims, objectives and significance of the study are also explored.

2.2 Drivers of air transport growth in SADC

The principal drivers for demand for air travel in SADC are many; the major being ones being economic growth, trade, topology, social needs and regulations. As already noted in chapter one, the SADC region has witnessed significant economic growth. Whilst it is acknowledged that there is inequitable distribution in GNI per capita in SADC states, the steady rise in national income has witnessed the emergence of middle income consumers who can afford

intra-regional air travel and act as stimulant for growth (World Bank, 2010). A recent World Bank study (2010) on passenger profiles on intra-African flights, established that regional flights are dominated by passengers visiting friends and relatives (VFR) as these constitute 60 percent. Business travel (both traditional (20) and small business/traders (18)) contributed 38 percent and tourism accounted for only 2 percent of the passengers. The VFR traffic includes immigrant workers that rely on air transport to visit their countries of origin.

The easing of trade restrictions within the SADC has resulted in an upsurge in cross-border business transactions. Big businesses and small business/ traders are key players in economic activities of many SADC states. The majority of business transactions still require face-to-face meetings and hence the higher percentage of business travellers on regional flights.

Social needs such as the need for cohesion, access to remote regions and the need to deliver much needed supplies such as medicines; drive air transport growth in some SADC states. The importance of tourism as a major contributor to economic growth is another stimulant for growth in air transport. For island nations and some continental SADC states, air transport is the only mode of travel that can ensure access to many tourist destinations. The cost and time taken to build surface transport infrastructure have accounted for the marked increase in the use of air transport in many SADC states .An example is Angola, DRCongo and Mozambique where decades of civil war destroyed infrastructure.

The removal of restrictions on intra-SADC city-pairs has also driven the growth in demand for air travel. City-pairs with no restrictions on airline designation and frequencies have experienced phenomenal growth and have witnessed higher passenger volumes.

2.3 The case for air transport liberalisation

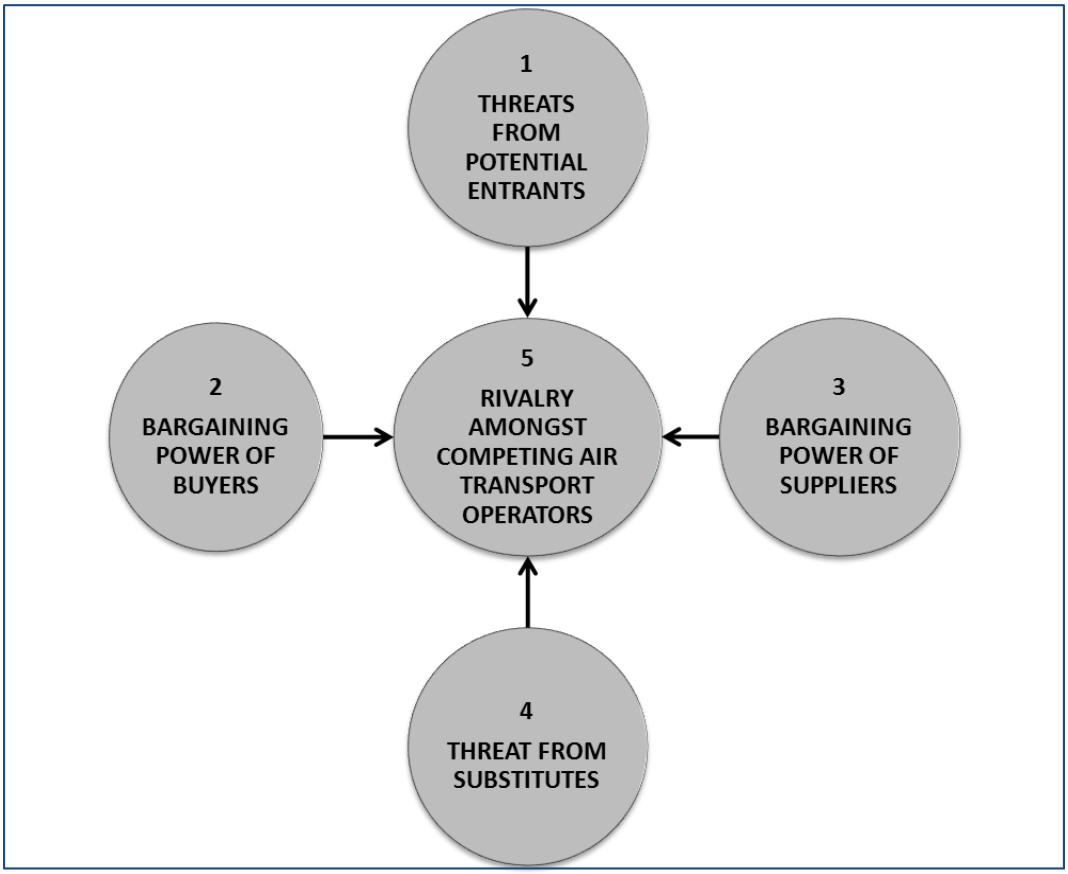
The U.S. was one of the earliest advocates of air transport liberalisation (Oum, 1998). The U.S. had unsuccessfully pushed for open competition in

international air transport way back in 1944 at the Chicago Convention. Underpinning the liberalisation strategy is the debate amongst economists on the role of government in the market place (World Bank, 1991; Bergeijk, 1996). On one hand are Keynesian[2] economists who advocate for the active participation of the state in business affairs of the nation. On the other hand are the proponents of free-market (laissez-faire) policies who rationalise minimal government intervention in the operations of the market. The free-market theory is attributed to Adam Smith's metaphor of the invisible hand. The argument is premised on the notion of the equilibrium and efficiency of markets; where it is hypothesised that suppliers compete for the favour of buyers and consumers make informed choices about the prices and quality of products offered to them (Bergeijk, 1996). Liberal theorists are of the view that government intervention in the market must be limited to such issues as the provision of infrastructure, enforcement of laws, security of a nation and protection of the citizens from crime (Smith, 1977). Advocates of air transport liberalisation subscribe to this theory and argue that excessive regulation interferes with the operations of a free market with a number of undesirable results (O'Connor, 1995; Oum, 1998).

2.3.1 Market forces inherent in the intra-SADC regional air transport

Porter (1980) identifies five market forces whose collective strength determines competitiveness and profitability of a market. The five forces that represent both the supply and demand dynamics of a market are illustrated in Figure 2-1. They are used in this section as a simple model to facilitate discussion and examination of the likely impact of government intrusions in the operations of the air transport market.

[2] Ascribed to the work pioneered by the economist John Maynard Keynes in the 20th century



Source: Adapted from Porter (1980)

Figure 2-1 Illustration of market forces inherent on the intra-SADC air transport market

2.3.1.1 Threats from new entrants

The threat of new airlines entering SADC's air transport market is real. However, the entry of new airlines brings extra capacity and intensifies competition (Porter, 1980). Economists argue that an increase in capacity often leads to lower prices (Bergeijk, 1996). In addition they argue that the threat of new airlines restrains existing players from irrational pricing behaviour. This is because there is a threat to market share and increased costs either through competition for supplies or increased spending on advertising so as to protect market share. It is assumed that the effect of threat of new competition pushes existing firms to find innovative ways to keep their costs down and improve their service so as to create barriers to entry. A heavily regulated intra-SADC air

transport market, as noted in section 1.1.4, poses high barriers to entry and exit and tampers with the market.

2.3.1.2 Threats from the bargaining power of buyers

This describes the influence air travellers (passengers, cargo and mail) can have on SADC airlines. Porter (1980) argues that buyers can exert their value by forcing down prices, bargaining for higher quality or improved services and by playing competitors against each other. Porter (1980) maintains that if buyers are powerful firms operating in an industry will find it difficult to pass on any cost inefficiencies in the form of higher prices. The general effect of consumers on an industry is that firms will be compelled to find ways of minimising the cost of producing and distributing goods and services.

2.3.1.3 Threats from the power of suppliers

Major suppliers to the SADC air transport play a key role in the operations of the region's airlines and consequently their performance. The major suppliers on the intra-SADC air transport network are airport operators, air navigation service providers, labour, aircraft manufacturers, fuel companies and insurance providers. Suppliers exert bargaining power by threatening to raise their prices and reduce the quality of their goods (Porter, 1980). Depending on the vital importance of the supplier and the power of buyers firms are compelled to engage in strategies that are aimed at beneficial relationships with suppliers. The other option is to switch to cheaper sources. However, government restrictions on airport access distorts the ability of airlines to choose the airports to fly to, the city-pairs to serve and the type of aircraft that are appropriate for their operations. In addition, state intervention in labour issues and the purchase of aircraft fleet often distorts airline management decision-making.

2.3.1.4 Threats from substitutes

The availability of substitute products impacts the performance of the intra-SADC air transport network. Porter (1980) argues that substitutes have the effect of placing a cap on how much firms in an industry can charge for their

product. He identifies three possible sources of threats as alternative products within the same industry, in different industries and alternatively buyers choosing to go without the products. For SADC's scheduled regional air transport market, alternative products exist in the form of private charter flights. Surface transport (rail and transport) are major substitute products particularly on short distances. Furthermore, people can opt to stay at home and conduct meetings through electronic media such as video conferencing rather than travel for face to face meetings. Economists posit that faced with a number of substitute products firms in an industry have an option to reduce their prices to match competition or stimulate demand. As stated before, SADC airlines did not have the flexibility to compete with substitutes by adjusting their fares.

2.3.1.5 Competitive Rivalry

The number of players in the intra-SADC's air transport market determines the intensity of competition. Bergeijk (1996) argues that the degree to which firms are able to enter or exit markets, to grow and contract, to innovate or imitate new products and to discover and new production process determine the competitiveness of a market. Economists note that better competition often leads to an expansion of the available supply of goods and services, the lowering of fares, increased efficiency, technological innovation, improved services and accelerated growth of air transport (Bergeijk, 1996; Williams, 2000). Competition theory assumes that any excess in supply of capacity will result in price decline and ultimately marginal firms will exit the market. In the case of excess demand the reverse is expected.

The free market ideology is not without flaws. It is premised on conditions for perfect competition that are too liberal to be met in any market. The World Bank (1991) agrees that competitive markets are the best way yet found for efficiently organising the production and distribution of goods and services. The bank however is of the view that the operation of a market is not a question of state or market because both have a large and irreplaceable role. It further argues that markets cannot operate in a vacuum; they require a legal and regulatory framework that only governments can provide. The bank also points out that; "in

many other tasks markets sometimes prove inadequate or fail together. That is why governments must for example invest in infrastructure and provide essential services to the poor."

2.3.2 Motivation for adopting civil aviation reforms in SADC

On attaining independence SADC states adopted interventionist policies and expanded the role of government in every sector including the air transport industry. Tanzania for example had at some point adopted socialist oriented policies whose effect intensified government involvement in all sectors (Freund, 1981). Other states such as Zimbabwe, Mozambique and Namibia, shared and followed similar state pioneered developmental strategies. All SADC countries inherited state owned airlines and airports from the colonial past (Schlumberger, 2010; Chingosho, 2005). Although many of the airlines were not profitable particularly on domestic markets, their loss making operations were subsidised by government. The reasons for keeping these airlines in business varied. For some countries, they were the only way by which economic, social and political links with former colonial authorities were sustained. Examples are Air Zimbabwe and Air Malawi facilitating travel and trade with the United Kingdom and TAAG Angolan airlines linking their home country to Portugal. For huge countries such as the DRC air travel is the best mode of transport that helps travellers and trade to overcome the friction of distance.[3] Some countries too small to sustain operations subsidized their airlines for nationalistic pride (Chingosho, 2005).

However, government interference hampered the ability of airlines to adapt to changes in demand for air transport as trade and tourism grew. They also impeded efforts to take advantage of the new market opportunities brought about by globalisation of economies, the rise in urbanisation and immigration as well as increased business activities by multinational companies. The liberalisation of international air transport markets such as in the EU ushered in stiff competition from mega-carriers (Schlumberger, 2010). Due to budgetary

[3] Friction of distance is based on the notion that the interaction between places is impeded by distance. Interaction is higher for shorter distances and it decreases as distance increases.

constraints and large budget deficits in the early 1990s governments could not afford to continue subsidising loss making airline operations from the public purse. A number of SADC nations could not afford to replace the ageing fleet with new and better planes on the market. As airlines were also a source of employment in many domestic markets, governments were reluctant to liquidate them. The net effect was weak and struggling airlines and an uncompetitive airline industry. Regardless of the teething problems and contradictions, it was imperative that SADC should embrace air transport liberalisation given the critical importance of a competitive regional airline industry for regional economic cohesion, integration and social development.

2.3.3 Main elements of SADC's air transport liberalisation

Liberalisation in air transport entails the withdrawal of state involvement in the provision, funding and regulation of air transport services, (Bowen, 2002; Button and Stough, 2000; Oum, 1998; Morrell, 2007; Williams, 2000; Simon, 1996). SADC chose to use three key features that the International Monetary Fund and the World Bank recommend for structural reform strategies. These are privatisation, deregulation and competition policy. Liberalism in national air transport markets took the form of privatisation and deregulation. The easing of controls within the regional air transport market was undertaken as part of the construction of a common market and SADC reoriented the sector towards an open skies policy.

2.3.3.1 Privatisation

The World Bank defines privatisation as the transfer of ownership of public assets from the state to the private sector. Describing privatisation as a process that allows the share of the private sector to grow until the private sector has become the dominant sector of the industry, Bergeijk (1996) argues that the strategy goes beyond physical assets. He identifies three aims in privatisation as to;

a) Sell or recapitalise public firms to the private sector
b) Aim at substituting private for public services

c) Encourage the application of the direct benefit principle and introduce private sector principles, management techniques and procedures into public sectors.

Air transport privatisation relates to the removal of national ownership restrictions on airlines, airports and air navigation services. This has seen many governments disposing part or all ownership interests in airlines and airports to the private sector. It is believed that privatised entities (airlines, airports and their operations) become more agile competitors, grow faster and spawn new routes (Oum, 1998). Morrell (2007) cites increased efficiency and accountability as two of the strategic reasons behind privatisation in civil aviation. Another benefit that the liberal market theory puts forward is that the opening up of the airline industry to private sector participation would result in the market entry of more airlines, expansion in output and the replacement of less efficient firms by better ones (Chou,1993). Indeed, Bowen (2002) attributes the proliferation of low cost airlines in the U.S., the EU, Asia, and Latin America to the opening up of the industry to private sector participation.

2.3.3.2 Deregulation

According to the World Bank deregulation involves the reduction or elimination of state rules over economic and social activities, and their replacement with market modes of governance. Bergeijk (1996) argues that deregulation aims at three simultaneous goals; less detailed rules (especially less competition restricting rules), greater use of market forces and a clear division of responsibilities between the market and public sector. In the airline industry deregulation relates to the removal or relaxation of restrictions on routes, traffic rights, airline designation, access to airports, frequency, capacity and tariffs (passenger fares and cargo rates). In a deregulated environment, airlines are believed to have greater autonomy over where and how often they fly (Bowen, 2002).

2.3.3.3 Competition policy

Competition policy is the body of laws and regulations that are aimed at regulating the conduct of firms in an industry. Premised on the notion that more competition does not mean less regulation, the argument is that the proper functioning of an industry requires at least protection of property rights, enforcement of contracts, laws on monopolisation and mergers and acquisitions (World Bank Development Report, 1991; Bergeijk, 1996).

2.3.3.4 Open skies policies

Open skies policies relate to bilateral or multilateral agreements, between and among different countries that liberalise the rules for international aviation markets and minimise government intervention (Elek, Findlay, Hooper and Warren, 1999; Schlumberger, 2010). The net effect is found in the removal or relaxation of such barriers as; airline designation, airport access, fares and the creation of an environment which encourages the participation of foreign carriers and investors. With more flexibility to choose airports, select routes, choose aircraft and set fares and rates, airlines (both domestic and foreign) are free to increase service and restructure their networks in response to demand patterns (O'Connor, 1995). The ultimate objective of a regional open skies policy is the creation of a single aviation space.

2.4 SADC's air transport restructuring strategy

SADC is a signatory to the YD, one of the regional agreements lodged with the ICAO. SADC also uses the SADC protocol on TCM that became legally binding with effect from July 1998.Chapter 9 of the SADC protocol on TCM provides the basis on which the restructuring of civil aviation is anchored with article 9.1 listing two objectives;

- The provision of safe, reliable and efficient services
- Enhancement of commercial viability and competiveness of air services

The African Union (2005) argues that in the YD, African countries have a potent instrument for the development of the air transport industry. This is because the

liberalisation of air transport services and the fair competition envisaged in this initiative has potential for the “strengthening of African carriers, improve their capitalisation and minimise their operating costs.” The expectation was that carriers would embark on fleet and network expansion to improve service quality on a continent lagging behind in airline network connectivity and experiencing comparatively high costs of air travel (AU, 2005).

An examination of the key features of the liberalisation strategy is summarised by Table 2-1. This research focuses on the key issues that are critical to air transport network design and were considered to present high barriers to entry. The assessment of the two legal instruments focuses on the sections dealing with the exchange of commercial traffic rights, the setting of prices, determination of flight operations, designation and ownership of airlines and competition issues.

Table 2-1 Key features of SADC's air transport liberalisation strategy

Provisions	SADC Protocol	Yamoussoukro Decision	Remarks
Objectives	The gradual liberalisation of intra-SADC air transport markets for regional carriers	The gradual liberalisation of scheduled and non-scheduled intra-Africa air transport services	
Scope of reforms	National and intra-SADC air transport markets	Intra-Africa air transport markets	
Traffic rights	Silent on rights	Free exercise of 1st , 2nd , 3rd , 4th and 5th freedoms of the air (Article 3). The rights are granted on scheduled and non-scheduled passenger and freight (cargo and mail) commercial flights performed by eligible airlines	Restrictions on 5th freedom traffic rights, were allowed for limited maximum period of 2 years and this expired on 12 August 2002.
Tariffs	Silent on tariffs	Requirements for approval on airline tariffs for the carriage of passenger, cargo and mail as is required by the aeronautical authorities removed(Article 4)	Designated airlines are only required to file such tariffs with competent authorities 30 working days before they enter into effect. In the case of lowering tariff these take immediate effect according to the will of the airline.
Frequency and capacity	Silent on frequency and capacity	Restrictions on the number of frequencies and capacity offered on air services connections lifted (Article 5). Eligible airlines are allowed to mount and operate such capacity and frequency as they deem appropriate	Limits on traffic volume, the type of aircraft, and number of flights per week are only allowed on environmental, safety, technical or other special consideration
Airline designation	Silent on this	Multiple designations of airlines permitted (Article 6). Article 6.2 and 6.3 permit designation of airlines from within the AEC as well as African multinational airlines	The provisions also allow a state to designate an airline from another member state to operate on its behalf
Airline competition	Silent	Article 7 provides for the establishment of competition rules	
Airline ownership	Commercialisation, deregulations and regionally owned airlines	Encourages privatisation, deregulation and consolidation of airlines	

Source: Compiled from an evaluation of the provisions in the YD and SADC TCM

It is envisaged that SADC's restructuring strategy would be capable of delivering a network that best meets the needs of the regional community. The strategy agenda foresees a situation where national governments move away from the day to day operations of airlines, runways and air traffic control services to focus on effective regulation of the industry. It permits market forces the flexibility to determine markets that should have direct flight connections. The strategy creates room for airlines to flourish and grow as it encourages consolidation of SADC carriers, cross border capital flows, foreign investment in the airline industry and the creation of regional airlines. To ensure orderly and sustainable provision of airline services, the strategy permits the creation of competition regulations. It is important to note that reorienting the civil aviation institutions and ensuring the participation of the private sector is inherently a protracted political process. The World Bank Development Report (1991) cautions that the private sector may fail to deliver the efficient network and governments may have justifiable reasons to intervene.

2.5 Characteristics of efficient air transport networks

Published literature on transportation networks suggests that one of the main features of a network is mobility; defined as the ease of travelling from one location to another within the same network (El–Geneidy and Levinson, 2011; Paleari et al, 2010). A number of studies have concluded that everything else being equal, users of transportation systems prefer shorter, faster or more generally less costly paths (Cento, 2008; Bell and Lida, 1997; Kanafani, 1983). In air travel it is argued that travellers prefer direct flights. When multinational companies make investment location decisions, they want to know not only how many destinations they can fly to from a certain airport, but also how far these destinations are and, therefore, how long the flight would take and how much it would cost (Goedeking, 2010; Cento, 2008).

One can conclude that from the air travelers' point of view, a regional aviation network is said to be efficient when it;

- Offers easy travel in any direction (from one airport to another)

- Can facilitate access to valued destinations
- Offers the shortest possible paths and
- Offers less costly alternative paths between airports

Passengers generally desire frequent, direct or non-stop and reasonably priced connections between each city-pair in the network (Mason, 2000). Where such connections are not achievable between all city-pairs, an efficient network still facilitates rapid connections through third cities. For a service to be reasonably priced, published literature on transport economics state that market competition must exist (Morrell, 2007).

Air transport literature is replete with countless measures by which the features of efficient networks have been described. Some of the measures that appear consistently in many studies on transportation networks are connectivity, accessibility, circuity and competitiveness.

2.5.1 Network connectivity

Sokol (2009) defines connectivity as a measure of the degree to which a network as a whole or its parts is internally connected or linked. This, he argues, can be judged by "the ease with which people, materials and information can be moved from one location to another, within and between regions." In air transport, connectivity relates to the degree to which people are able to travel to other cities through airline services (Chou, 1993). Connectivity is desirable as it presents a wide range of destination choices for both passengers and cargo. In SADC, as in any other part of the world, higher network connectivity is desirable as it eases the movement of persons, goods, equipment and services; a feature essential for regional economic and social integration.

2.5.2 Network accessibility

Various definitions exist for this term whose origins Handy and Niemier (1997) trace to Hansen (1959). According to Handy and Niemier (1997) accessibility relates to the potential of opportunities for interaction. Reggiani and Martin

(2011) suggest that accessibility measures the propensity of economic actors or users to reach certain economic activities or destinations. Various authors describe accessibility as the measure of the ease with which one place can be accessed or reached from another location, or to provide access to other locations (Chou, 1993; Sokol, 2009; Wachs and Kumagai, 1973; Rodrigue *et al,* 2009; Reynolds-Feighan and McLay, 2006). In air transport accessibility is measured by how easily one airport can be reached from all other airports in the same network. Accessibility is desirable as it offers cities opportunities for social and economic interaction and the potential for growth and development. For SADC higher accessibility is ideal as it offers cities the opportunity to receive significant flows of visitors, trade and investment.

2.5.3 Network circuity

Circuity relates to the ability to move independently between a region's major economic centres (e.g. going from airport A to C, without having to go through airport B). In air transport, circuity is measured by the degree to which the design of the network overcomes the friction of distance. Friction is defined as the difficulty of moving a volume (passengers or goods) per unit of distance Rodrigue et al (2009). According to transportation literature, distance determines the quantity of interaction between places. Distance is considered an impediment to spatial interactions because as distance increases so does cost in terms of time and money.

The qualities of direct and indirect connections in an air transport network are not the same (De Wit et al, 2009). Passengers using indirect connections between airports experience additional costs due to longer travel times as a result of detour distance. Reduced circuity lowers travel costs in terms of time and money. As movement becomes less costly demand for air travel is often stimulated. Reduced circuity is therefore the preferred option in the developing region of SADC as it lessens travel costs and would in turn stimulate demand for air travel.

2.5.4 Network competitiveness

The ease with which passengers or cargo are able to move within an air transport network cannot be judged just by the number of connections that exist between the major economic centres because the number of airlines serving the network determine the quality of the connections.

Market concentration is considered a key determinant of conduct and performance of airlines on city-pairs. In economic theory, market concentration is a measure of the number and size distribution of sellers (Bergeijk, 1996). Arguing that high levels of concentration advance the leverage sellers have vis-a-vis buyers, economists posit the differences in market concentration distinguish the theoretical models of perfect competition, oligopoly and monopoly. Market concentration is high when the industry is dominated by a small number of large firms. In air transport, an efficient network fosters airline competition. In the absence of competition the incentive to increase services, innovate and even lower fares is assumed to be absent (Bowen, 2002). For SADC, a region defined by low disposables incomes, a network characterised by a sizeable number of competitors is desirable as competition amongst airlines would lower fares, encourage innovative products, stimulate demand and ultimately improve the performance of the airlines serving the network. As air travel is a derived demand a higher number of frequencies would likely allow travellers particularly business traffic to pick convenient flights.

However the political will of national governments plays a significant role in establishing, maintaining and changing the geography of the regional civil aviation network to ensure these four features (connectivity, accessibility, circuity and a competitive market) exist. It is for this reason that IATA (2012) proposes deeper and wider air transport liberalisation as the appropriate instrument by which policy makers could develop efficient civil aviation networks.

2.6 Post liberalisation era

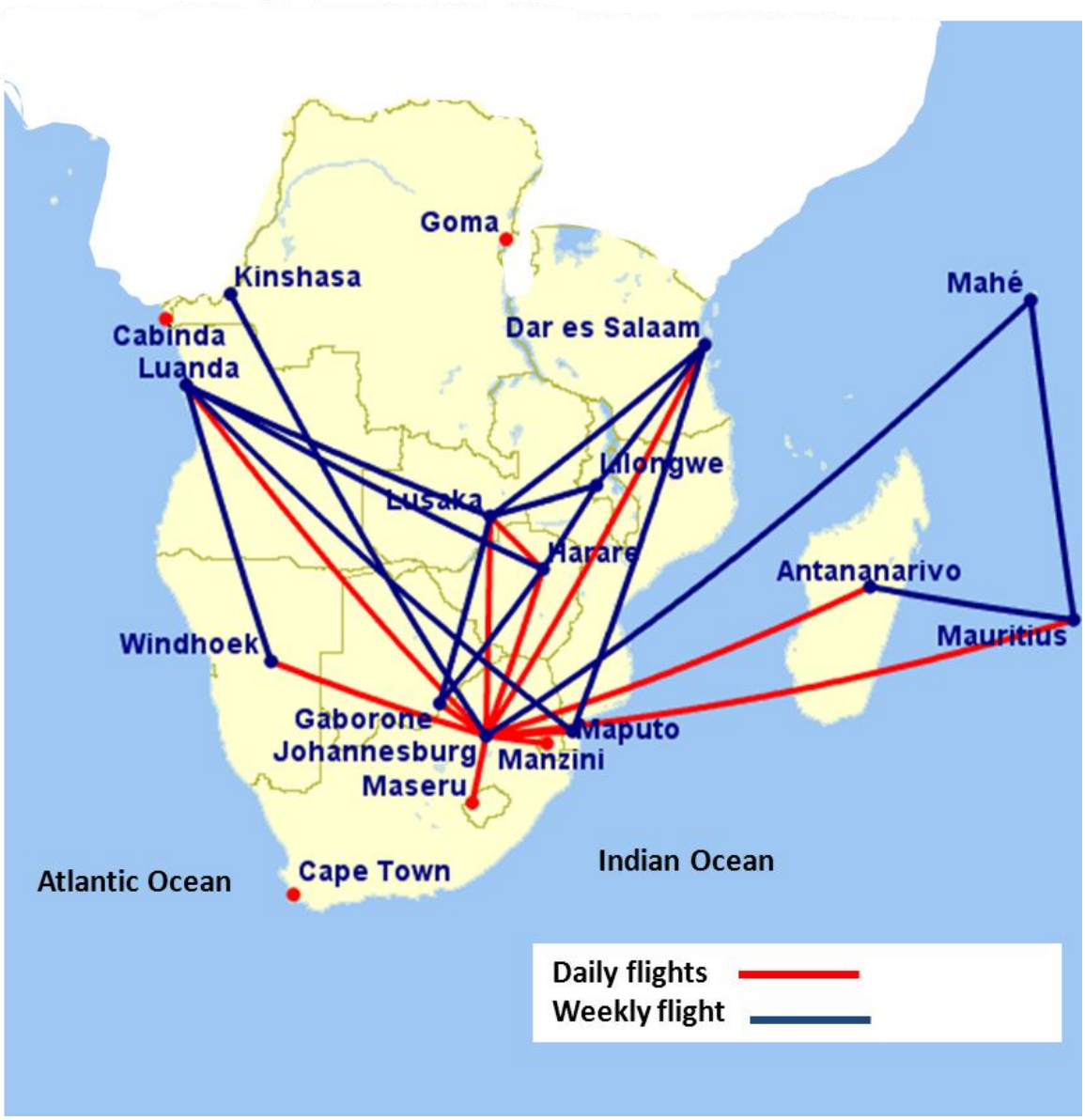
An ideally integrated intra-SADC network is one that links at least the key economic and population centres of each of the SADC member states. These centres are defined by those airports handling the largest volume of traffic in each of the member states.

2.6.1 Current network structure

Using direct flight connections between the busiest airports in each of the SADC states as of April 2011, the study was able to assess whether the efforts aimed at reorienting regional civil aviation reforms towards market orientation had achieved the intended key results. Data on scheduled flights was sourced from OAG Schedule iNET. Where there were discrepancies, airline websites were consulted to consolidate the data. All the airlines in SADC maintain websites on which their flight schedules are freely available. The post liberalisation network is presented in Figure 2-2.

Despite undergoing restructuring since July 1998, the network structure existing as of April 2011 depicts regional air service connections that fall far short of delivering an ideal integrated air transport network. The number and size of airlines serving the intra-SADC network has shrunk while some airlines went bankrupt consequent of liberalisation (see Appendix B). A few of the new airlines that entered the market failed to establish a foothold and exited the market. Restrictions on airline designation still exist on a few city-pair connections. Failure to raise sufficient credit to finance airline businesses has been another key obstacle to entry in the intra-SADC network.

As a result, out of a possible 105 city-pair connections for a fully connected regional network, only 28 exist. Many of the major economic centres have no direct connections between them. Connections between continental member states and islands are only possible through South Africa. Also, the busiest airport in the DRC has one link with Johannesburg that gives it indirect access to all other member states.



Source: Map created using Google Circle Mapper (copyright © Karl L. Swartz) and based on data from OAG Schedule iNet.

Figure 2-2 Post-liberalisation intra-SADC air service connections as at April 2011

2.6.2 Nature of flight frequencies

The number of flights operated on a city pair are an important determinant of service levels and connectivity between places (Vasigh, 2008). This study carries out an examination of the nature and distribution of flight frequencies on the intra-SADC network as of April 2011. The assessment which is presented in Figure 2-2 above reveals that half of route connections had no daily airline

service as at April 2011. With the exception of the Harare-Lusaka city-pair, all daily connections are out of Johannesburg, South Africa. This discrepancy is largely because of the domination of the intra-SADC network by South African carriers particularly South African Airways and its strategic partners (South African Express Airways and Airlink). The problem is further exacerbated by the failure by a number of state owned airlines to invest in smaller regional aircraft that are suited to thin-routes. There are also a few city-pairs where regulatory restrictions on flight frequencies still exist.

2.6.3 Market competitiveness

The goal of liberalisation was to encourage competition and remove monopolistic tendencies on the intra-SADC market. The size and number of airlines on the intra-SADC network reveal a different picture. For those countries that removed entry barriers, the new airlines have not survived for a long time; either because of financial problems or predatory behaviour from incumbent carriers. The successful entry of new airlines has tended to happen more on domestic markets than the intra-SADC market. A few attempts at privatisation in state owned airlines failed to take off because of financial issues and political considerations. Although a few joint ventures have succeeded, some were reversed and others collapsed. The majority of governments have maintained a hold on airlines with most of them struggling to survive. In a few countries entry barriers in the form of airline designation and capacity restrictions that are aimed at protecting state-owned airlines still exist.

Consequently, a sizeable number of the city-pairs are characterised by monopoly and duopoly tendencies. South African based airlines dominate the market. At the onset of reforms, these carriers accounted for 28 per cent of total flight frequencies on the intra-SADC network. At April 2011, the market share of South African based carriers (in terms of flight frequencies) had risen to 60 per cent.

2.6.4 Quality of the intra-SADC flight connections

The failure of some SADC states to encourage more airlines on city-pairs serving their countries has a negative impact on the efficiency of the regional network as a whole. An assessment of the co-ordination of flight schedules on a few city-pair connections suggests that SADC nationals and visitors to the region still experience difficulties when they require connecting flights to reach chosen destinations. A sample of six capital city-pairs with infrequent or no direct air service connections were assessed to determine the ease with which a passenger could get a connecting flight between the two cities. The analysis entailed a basic calculation of time taken when connecting through the regional hub of Johannesburg. The findings presented in Table 2-2 show that an intra-regional flight that would typically take 3 hours if the connection were direct and nonstop, takes up to 14.5 hours more. The six city-pairs were selected using the following criteria;

a) A regional tourism initiative that pairs the two countries and is likely to trigger inter-country travel (Mozambique and Zimbabwe, Zambia and Botswana, Namibia and Botswana).
b) The possibility of intra-regional trade as Botswana's economy improves and the country's firms seek investment opportunities in Angola and the DRC
c) Cultural and language ties between Angola and Mozambique stimulating demand for recreational and social activities

Table 2-2 A sample of travel times on six city-pairs with irregular or no direct and nonstop air service connections

Route	Air Travel Distance	Air Travel Time on Direct service hrs	Available Connecting Route	Air Travel stage 1	Waiting time for next flight	Air Travel stage 2	Total Travelling time	Hours saved by Direct services	Remarks
HRE-MPM	910	1.2	HRE-JNB-MPM	1.8	4.7	1	7.5	6.3	
LUN-GBE	1,066	1.4	LUN-JNB-GBE	1.9	5.1	1	8	6.6	
WDH-GBE	929	1.2	WDH-JNB-GBE	1.8	4.7	1	7.5	6.3	
FIH-GBE	2,539	3.4	FIH-JNB-GBE	4	13.3	1	18.3	14.9	next day arrival
MPM-LAD	2,793	3.7	MPM-JNB-LAD	1.3	16	3.3	20.5	16.8	next day arrival
GBE-LAD	2,224	3	GBE-JNB-LAD	1	13.2	3.3	17.5	14.5	next day arrival

Airport Codes

FIH	Kinshasa- Democratic Republic of Congo	LAD	Luanda - Angola
GBE	Gaborone- Botswana	LUN	Lusaka - Zambia
HRE	Harare - Zimbabwe	MPM	Maputo- Mozambique
JNB	Johannesburg- South Africa	WDH	Windhoek- Namibia

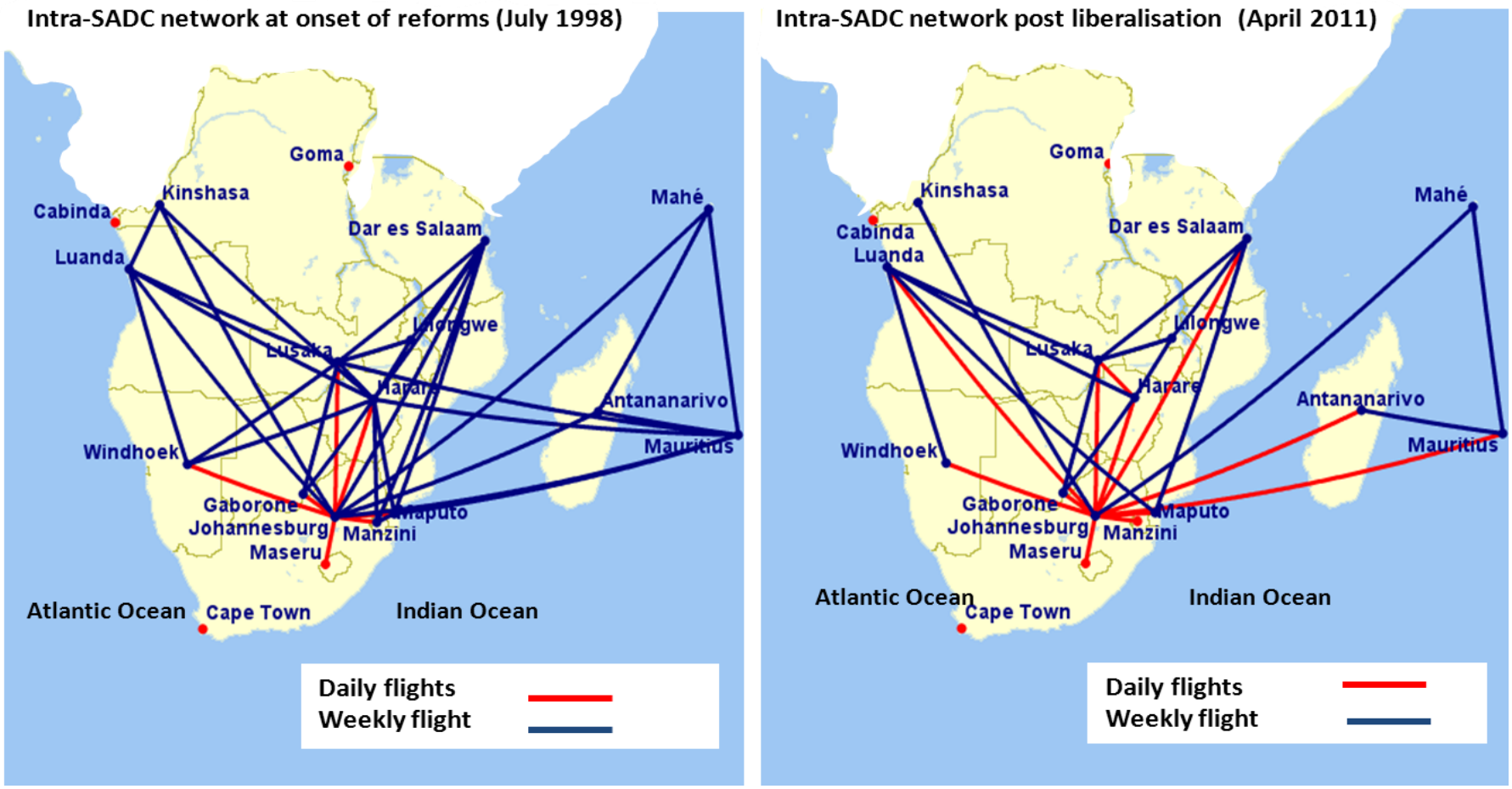
Source: Created using OAG Schedule iNET, SADC airline websites[4] and information obtained from Google Circle Mapper ((copyright © Karl L. Swartz)

Despite the high frequency of flights out of Johannesburg to Gaborone and Maputo, travellers between the DRC and Botswana, Mozambique and Angola, and Angola and Botswana cannot complete their journey in a day because current flight schedules do not permit coordinated connections. This situation suggests that the intra-SADC network is still underdeveloped and from a user's perspective the option would be to switch to alternative means of transport or to stay at home and rely on telecommunication technology for business interactions.

[4] South African Airways, Comair, TAAG Angolan airlines, Air Zimbabwe, Air Namibia, Hewa Bora

2.6.5 Network structure compared to pre-deregulation era

The network changes achieved by the liberalisation strategy are best assessed from the structural transformation that has occurred since July 1998. A comparison of the network layout at April 2011 to the one that existed at the onset of reforms in July 1998 is used to illustrate the problems besetting the intra-SADC network. Figure 2-3 below reveals that save for marginal gains in daily flight frequencies, air transport liberalisation has not delivered a network that is “accessible, reliable and capable of facilitating freedom of movement within the network in any direction.” Efforts at restructuring have actually resulted in achieving a fragmented network as landlocked countries such as Zambia, Zimbabwe and DRC have lost direct air service links with a number of SADC states. Social and cultural links between continental member states and Seychelles and DRC are constrained by the absence of daily connections.



Source: Map created using Google Circle Mapper (copyright © Karl L. Swartz) and based on data from OAG Schedule iNET

Figure 2-3 Comparative analysis of regional air transport network changes since onset of reforms

2.7 Research problem

SADC regards transport in general to be “a prerequisite for the promotion of economic growth and development and the improvement of the quality of life and social interaction of all the citizens within the region, continentally and internationally.” With seven landlocked states and three islands, air transport serves as the only mode of transport that can facilitate speedy and effective economic and social interchange within the community. A fragmented SADC air transport network does not fulfil that connectivity function and as a result the regional economy suffers; and so does social integration. SADC’s strategic direction, since 1994 has been to position itself as an attractive destination for foreign investment and international tourism. International movements of people and goods on the intra-SADC network depend on regional connectivity. SADC requires an integrated regional aviation network to promote foreign investment and international tourism flows.

Recent research on the YD (Schlumberger, 2010; AU, 2011; SADC, 2009) finds that the current civil aviation restructuring strategy, both in substance and form, is able to deliver an integrated, efficient and demand driven network. So far the apparent fragmentation of air service connections in SADC in the midst of a transformation process reflects poor implementation strategy coupled with air transport market imperfections. SADC needs to meet the conditions necessary and sufficient for effective strategy execution. However, the fragmented network structure also suggests insufficient demand. Airlines are a business after viable investment returns and they decide the markets that receive air service connections on the basis of profitability. New routes have no appeal when they add no meaningful contribution to the airline business. Existing SADC air routes with seasonal demand patterns are often abandoned during low seasons. Getting knowledge on how strategy execution and demand patterns had a bearing on the problems besetting the intra-SADC network is vital if SADC is to take the measures necessary to ensure the initial objective of network restructuring is fulfilled. Finding answers to these problems form the research aims of this study.

2.8 Research aim

This study aims to offer specific measures for SADC members to apply and improve, intra-SADC air service connections, either individually or collectively.

2.9 Research objectives

The objectives derived from the above aim are to;

a) Benchmark the intra-SADC civil aviation network to other developing regions that are implementing regional civil aviation reforms
b) Establish the potential demand on intra-SADC city-pairs
c) Examine the factors accounting for strategy implementation failure in SADC
d) Identify the ideal demand driven intra-SADC air transport network
e) Recommend measures that SADC member states should take to improve intra-SADC air service connections

2.10 Significance of the study

The transformative effect of liberalisation policy on regional air service connections in SADC countries is a subject that has so far received little or no attention in academic debate and literature. This study seeks to bridge that gap. Indeed, the applicability of open skies policies to SADC and other parts of Africa characterised by sparse demand and remoteness is a subject that has drawn little academic scrutiny. This study contributes to existing knowledge and debates regarding air transport liberalisation in developing regions with particular focus on the African continent.

2.11 Conclusion

The intra-SADC air transport system has been undergoing a restructuring process well-known for delivering network efficiency for over a decade. However the process has not achieved positive results and in some respect the network has regressed. Network structure reflects strategy and sufficient demand is the backbone of any air transport network. Disintegration suggests

poor implementation of strategy and inadequate demand for air travel on the intra-SADC air transport network. This research aims to contribute new knowledge by benchmarking strategy execution and analysing demand patterns and at the same time proposing possible solutions that would alleviate fragmentation.

3 Chapter Three: Literature review

3.1 Introduction

The purpose of this research was to provide answers to the fragmentation of air service connections on the intra-SADC network. Central to this investigation was the need to explore, understand and explain the reason for the disintegration of service on an aviation network undergoing a highly regarded restructuring process. The ultimate goal of the study is to propose strategies to improve the region's air transport network.

The uncertainty surrounding SADC's airline industry has been partly addressed by few academic and consultancy studies that examine the slow pace at which liberalisation has been implemented. Some of the significant contributions came from Chingosho (2005), Schlumberger (2010), the African Union (2011) and World Bank (2010). The conception of this research was motivated by a desire to add to the understanding of the industry and its problems with a view to recommending possible solutions. The methods employed to provide answers to the problem besetting the intra-SADC network differed considerably from earlier works. The point of departure is the position taken on the issues to be addressed in order to find solutions to the disintegration characterising the network. Prior research had tended to lean towards an examination of the quantum of changes achieved by liberalisation and their relationship with deficiencies in air service provision. As yet, no studies have been undertaken to understand and explain intra-SADC air travel demand and its effect on air service connections and network design.

This research integrated theories, concepts and models borrowed from various disciplines particularly graph theory, strategic management, transport economics and civil aviation law. The study also adopted approaches used by numerous studies in other disciplines. This chapter is organized in four parts; the conceptual framework, a review of the literature, an assessment of the relevant literature and the research questions addressed in the study.

3.2 Conceptual framework of this study

The conceptual framework or the system of concepts, assumptions, expectations, beliefs, and theories that supported and informed this research is network analysis. Network theory is a well-established body of literature that has been used extensively by numerous studies in many disciplines to investigate any distribution system (physical and non-physical) that take the form of a network (Newman, 2003).

In network theory complex systems are abstracted and organised in the form of graphs with nodes connected together by edges (Kurant and Thiran, 2006). The graphs are then used to characterise networks and analyse their structure, evolution and quality. A node is defined as a point of origin or destination. An edge is a link between any two nodes. For air transportation, airports represent nodes and direct flights between the airports represent the links between the airports.

In mathematical terms, a graph consists of two finite sets; a set of finite vertices (nodes) with a finite set of connections linking those vertices (Kreyszig, 2005).Two extreme types of graphs are suggested by this approach; fully connected (complete) and minimally connected (incomplete) graphs. Furthermore network theory recognises two types of graphs; planar or non-planar (Barthélemy, 2011; Ivy, 1995; Taaffe *et al,* 1996). Planar graphs exist when the intersection of two edges (routes) is a node (vertex). These are found in surface transport networks where crossings are interconnected by interchanges. Non-planar graphs exist in systems where intersecting routes do not need a vertex. Maritime and airline networks fall into the category of non-planar graphs.

For the purposes of this study, the intra-SADC air transport network is abstracted as a graph and defined by the fifteen significant nodes that connect the key economic centres of the region. These are based on the busiest airports in each member state. A minimally connected network according to graph theory is one where each vertex (node) is connected to the network and none is

isolated from it. The precise number of edges needed to provide minimal connection is derived from the equation

$$e_{min} = (v - 1)$$ **Equation 3-1**

Where:

v= the number of vertices (airports) in the network

For the intra-SADC network minimal connectivity is **14** intra-SADC routes obtained by (**15-1**).

A maximally connected non-planar network is one where every one of the vertices is directly linked to each of the other nodes. The number of edges needed for maximum connection for non-planar networks is derived from the equation

$$e_{\max} = \frac{v(v-1)}{2}$$ **Equation 3-2**

Where:

v = the number of vertices in the network

A maximally connected intra-SADC network would have had **105 routes** resulting from $\frac{15(15-1)}{2}$.

Network theory contends that maximally connected graphs are rare. Network connectivity therefore ranges between minimally connected to close to maximally connected networks.

The properties of the intra-SADC network are described and explained within the context of a graph that is bound by a “finite” set of fifteen airports and a “finite” set of 105 linkages. This abstracted graph formed the unit of analysis for the research. The graph is used to consider, from a spatial perspective, the

level of interconnectedness of the graph (where it lies on the minimally to maximally connected graph). Defining the network and fixing the number of airports over the period under review simplified discussions on observed changes and proposals for improvements. Questions on deficiencies in strategy implementation and demand patterns are explored and explained in terms of their effect on the connectedness of the graph. The examination of demand on city-pairs on the intra-SADC network was based on the fact that those routes with adequate demand to justify direct flights or multi-stop flights would improve the connectedness of the network. Proposals on the design of an integrated and demand driven intra-SADC network are informed by the reality that well-connected graphs ought to approach maximal connectivity.

3.2.1 Network analysis approach adopted by this study

Burghouwt (2007) suggests two approaches that have offered researchers valuable tools and concepts for analysing aviation networks. These are the spatial and the temporal network analysis approach. The difference between the two is that the spatial approach considers the geographical variation of aviation networks (in terms of airports, routes and traffic flows) in space whereas the temporal approach focuses on the daily variation in time. These two approaches were both relevant for this study.

3.2.1.1 Spatial approach

Burghouwt (2007) cites graph theoretical studies, hub location models and studies using concentration and dispersion measures as grounded in the spatial approach. The usefulness of graph theoretical as well as concentration and dispersion measures lies in the fact that they are aimed at describing the spatial structure of networks. The two approaches differ in their strengths and weaknesses. The strength of the graph theoretic approach is that it facilitates conceptualisation of a network. Its weakness is its simplicity. Network concentration measures have the advantage of added information on the quality of the connections (in terms of the competiveness of the market). The focus of attention for hub location-allocation models is the spatial optimisation of hub-

and-spoke networks. Hub location-allocation models were considered inappropriate for the purpose of this study because the focus of this research is network structure.

a. Graph theoretical approach

Studies that have adopted graph theory are many and have contributed a broad range of indices by which the various aspect of the structure of a network can be analysed (Barthélemy, 2011; Burghouwt and Redondi, 2010; Kuby, Roberts, Upchurch and Tierney, 2009). Some of the seminal studies that have contributed significantly to graph theoretic approach are found in transport geography with Shimbel (1953), Garrison and Mable (1960), Kansky (1963,1989) and Taaffe and Gauthier (1973) leading the works. An authoritative study by Kansky (1989) made a significant contribution to the graph theoretic approach by developing 14 measures for network structure. The indices from these early studies became the basis for a series of adaptations that have been applied by various research projects to date (Witlox, 2011; Kuby et al, 2009).

A number of research projects have applied measures originating from graph theory to analyse aviation networks that have undergone restructuring. Some of the renowned studies are those by Chou (1993), Ivy (1995) and Bowen (2000, 2002). Using the graph theoretic approach, Chou (1993) investigated deregulation-induced changes in airport accessibility in the U.S. air transport network. Ivy (1995) used the same approach to examine the changes on the intra-European linkages for the period 1989 to 1993. Bowen (2000) applied graph theory in examining accessibility changes arising from liberalisation and airport development in South East Asia over the period 1979 to 1997.

b. Network concentration approach

Various measures of spatial concentration or dispersion of networks have been developed. Some of the measures that have been used to approximate market concentration in air transport markets, according to Burghouwt (2007) are the C4 concentration ratio, Theil/Entropy index (T), variances of logarithms (L),

Herfindahl-Hirschman Index (HHI), the coefficient of variation(V) and the Gini index (G). Some of the well-known studies that have used concentration and dispersion measures in air transport are Huber (2009), Reynolds-Feighan (2001) and Wojahn (2001).

3.2.1.2 Temporal approach

Described by Burghouwt (2007) as a recent development in academic air transport economic literature the temporal approach emerged from studies that have examined the daily variation of a network in terms of time. One of the outcomes of liberalisation is the development of hub and spoke networks by full service carriers; in their search for competitive advantage over low cost airlines. Proponents of this approach argue that passengers may prefer connections via third cities or hubs over direct connections if ticket prices for such connections are cheaper and frequencies are convenient (Burghouwt, 2007). Central to this approach is the proposition that passengers care about how they are routed and how much time they spend at a hub (Dennis, 1994).

A large number of studies have applied the temporal dimension approach to air transport network analysis. Dennis (1994) made a significant contribution to the temporal dimension approach by developing a connectivity ratio that was based upon schedule structure and indirect connectivity given minimum and connecting times. A number of studies have since adapted and made improvements to this technique. Some of the well-known studies were carried out by Bootsma (1997), Burghouwt and de Wit (2004), Danesi (2006), Malighetti et al (2008) and Paleari et al (2010).

The strength of the approach lies in the fact that it sheds light on the quality of network in terms of time taken to travel within it. The integration of this approach with spatial interaction methods would have provided useful insights into the interconnectedness of the intra-SADC network both in layout and in terms of travel time. However, this study did not utilise this approach as it was considered beyond the scope of the study.

This study uses the spatial approach by integrating graph theoretic and market concentration measures to explore and explain the disintegration of air service connections on the intra-SADC network. The advantage of this approach is simplicity and the ability to examine and make recommendations on the layout and airline competition on the network. The weakness of this approach is that it overlooks travel time between nodes, one of the most common and significant measure that modern network literature contends should be used to assess connectedness of restructured networks. This research considered one approach adequate for exploring and explaining the structural changes in SADC's air transport network.

3.3 . Graph theoretic measures

Kansky (1989) developed graph theoretic measures that are capable of facilitating examination of an entire network as well as individual assessment of routes and airports. The advantage of full network measures is that they provide just one number. The usefulness of individual measures on airports is that they provide an insight into their function or importance and accessibility to the rest of the network. It should be noted that the graph theoretic formulas that this research uses in calculating indices for network performance measures relate to non-planar graphs.

3.3.1 Measures of network connectivity

Numerous indices have been developed to measure connectivity. Most of them are relatively simple but give valuable information about the structure of a network (Haggett and Chorley, 1969; Taaffe and Gauthier, 1973; Rodrigue et al, 2006; Xie and Levinson, 2007). One major contribution on these indices came from the work of Kansky (1989) which put forward nine full network measures in three general categories listed below.

a. Measures that are not ratios (i.e. the cyclomatic number (**μ**), and the diameter (**δ**))

b. Measures expressing the relationship between elements of the network (i.e. alpha(**α**), beta(**β**), gamma(**γ**))
c. Measures expressing the relationship between the whole network and its elements (i.e. eta (**η**), pi (**π**), iota (**ι**), theta (**θ**))

Tables 3-1 to 3-3 serve to explain the three categories.

Table 3-1 Non ratio full network measures

Network Measure	Formula	Meaning	Interpretation
Cyclomatic number (μ)	**μ = *e*- *v*- *p*** Where ***e*** is the number of edges(routes) ***v*** is the number of vertices(airports) ***p*** is the number of isolated graphs (networks)	Uses the concept of a circuit that is defined as a finite, closed path starting and ending at a single node. It is an arithmetic comparison between individual elements of the system (airports and routes). Equal to the maximum number of fundamental circuits.	Highly connected networks have higher cyclomatic numbers.
Diameter (δ)	**δ (G) = $_x$ max $_y$ d(x, y)** where d is topological length between airports	This index measures topological length between airports (also known as the extent of a graph. It is simply the number of steps needed to connect the airports that are furthest from each other on one network.	Highly connected networks have lower diameters.

Table 3-2 Full network measures: relationship between network elements			
Network measure	**Formula**	**Meaning**	**Interpretation**
Alpha (α)	$\alpha = \frac{\mu}{\frac{v\,(v-1)}{2} - (v-1)}$ Where **μ** is maximum number of fundamental circuits. v is the number of vertices (airports)	It expresses the ratio between the observed number of circuits and the maximum number of circuits.	Index assigned numerical values between 0 and 1 to measure degree of connectivity. The index can also be multiplied by 100 and expressed as a percentage. Higher values indicate a more connected network
Beta (β)	$\beta = \frac{e}{v}$ Where e is the number of edges (routes) v is the number of vertices (airports)	Expresses the relationship between routes and airports in a network. Measures the average number of routes per airport.	The scale for the β index for non-planar graphs is from 0 to ∞. For networks with a fixed number of airports, an increase in the number of routes increases the number of possible paths and hence connectivity. A beta index higher than 1 usually indicates a high level of connectivity
Gamma (γ)	$\gamma = \frac{e}{\frac{v(v-1)}{2}}$ Where **e** is the number of edges (routes) v is the number of vertices(airports)	Measures the relationship between routes and airports. For a given network with a fixed number of airports, the index is the ratio of the number of observed routes to the maximum possible routes. The difference between γ, **α** and **β** is that gamma is a quotient of the observed number of edges to the maximum number of edges.	The index is assigned numerical values bounded by 0 on the lower limit and 1 on the upper limit. It can also be expressed as a percentage with a range between 0 and 100. The higher the gamma, the higher the network connectivity.

Table 3-3 Full network measures: relationship between the network and its elements			
Network Measure	**Formula**	**Meaning**	**Interpretation**
Eta (η)	$\eta = average\ edge\ length = \frac{M}{e}$ Where M is total mileage of the network (miles or kms) e is the number of edges (routes)	Expresses relations between the whole network and its routes. It is simply the relationship between the total mileage of the network and the observed number of routes.	As a measure of the average link length this indicates the adequacy of a network. An increase in number of routes increases mileage and average edge length.
Pi (π)	$\pi = \frac{C}{d}$ Where C is the total mileage of the network D is the network diameter	Evaluates the relationship between the whole network and its diameter This index is a measure of length per unit of diameter.	The index is ascribed values equal to or greater than 1. Higher numerical values of the **π** reflect higher degrees of development.
Theta θ	$\theta = \frac{T}{v}$ OR $\theta = \frac{M}{v}$ Where T is total traffic flow M is total mileage v is the number of airports	Evaluates the relationship of the whole network to its airports. The ratio can express the function of an airport. The index can also be used as an indicator of traffic density if information is available.	The measure indicates route lengths per airport in miles/kilometres. In a defined network with a fixed number of airports, an increase in routes increases route length per airport
Iota (ι)	$\iota = \frac{M}{w}$ Where M is the total mileage of the network w is the observed number of airports weighted by their function	Evaluates the relationship between the network as a whole and its weighted vertices The index according to Black (2003) computes the average passengers or tonnes per kilometre	The measure indicates lengths per weighted airport in miles/kilometres. An increase in connectivity improves the Iota index.

Source: Adapted from Kansky (1989) Measures of Network Structure

3.3.2 Measures of network accessibility

Given the variety of definitions that exist, many types of accessibility measures also exist. Various scholars argue that accessibility is a subject in itself (El-Geneidy and Levinson, 2010; Batty, 2009; Handy and Niemeier, 1997) and there are many measures for this concept. Unlike the concept of connectivity, accessibility is based on the explicit recognition of the importance of both characteristics of airports and the geographical distance between them. Many indices have been computed and presented in a number of ways. Kansky (1989) suggests three; associated number, dispersion and accessibility that are discussed in Table 3-4 below.

Table 3-4 Measures of accessibility

Network Measure	Formula	Meaning	Interpretation
Associated Number		Quantifies the maximum number of routes from a given airport to other airports.	The usefulness of the measure is that airports can be ranked in terms of their function in a network
Dispersion	$D(N) = \sum_{i=1}^{n} \sum_{j=1}^{n} = d(i,j)$ Where D is the distance from airport *i* to airport *j*	Measures the distance between each of the airports and all other airports in the network	This measure of distance is a sum of sums.
Accessibility	$A(i,A) = \sum_{i=1}^{n} = d(i,j)$	Measures accessibility of each of the airports to the network	Higher accessibility reflects "reachability" (Taaffe,1996)

Sources: Adapted from Kansky (1989) Measures of Network Structure

From these three measures, the simplest computation of airport accessibility would be the number of direct links that a particular airport has with other airports and the lengths of those links. The more direct links a particular airport

has with other airports in the same network, the higher its accessibility. Kansky (1989) suggests the accessibility of the full network be computed by aggregating the individual measures.

Another set of accessibility indicators that quantifies the relative positions of each node within a network have been developed through matrix manipulation. This has been achieved by representation of a network as an adjacency N X N matrix (connectivity matrix) where the number of rows and columns are equal to the number of airports in the network (Taaffe et al, 1996; Rodrigue *et al,* 2009). In this matrix, the horizontal rows represent origins and the vertical columns the destinations. The airports are represented both as origins (***i***) in the horizontal rows and as destinations (***j***) in the vertical columns. Each cell represents a connection between an origin and destination. The value in each cell is one (**1**) if there is a link between origin and destination and zero (**0**) if there is no linkage. This N x N adjacency matrix is manipulated to compute various accessibility indicators.

3.3.2.1 Degree of a Node

One of the accessibility measures that can be computed by using the connectivity matrix is the degree of the node. This measure is similar to the associated number mentioned in Table 3-3 above. Figure 3-1 presents what the N x N Connectivity Matrix reflected for intra-SADC air service connections as at April 2011.

	DAR	FIH	GBE	HRE	JNB	LAD	LLW	LUN	MPM	MRU	MSU	MTS	SEZ	TNR	WDH	Node Degree
DAR	0	0	0	0	1	0	1	1	1	0	0	0	0	0	0	4
FIH	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
GBE	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	3
HRE	0	0	1	0	1	1	1	1	0	0	0	0	0	0	0	5
JNB	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	14
LAD	0	0	0	1	1	0	0	1	1	0	0	0	0	0	1	5
LLW	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	4
LUN	1	0	1	1	1	1	1	0	0	0	0	0	0	0	0	6
MPM	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	3
MRU	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	3
MSU	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
MTS	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
SEZ	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	2
TNR	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	2
WDH	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	2

Airport Codes

DAR: Dar es Salaam
FIH : Lusaka
GBE: Gaborone
HRE: Harare
JNB: Johannesburg
LAD: Luanda
LLW: Lilongwe
LUN: Lusaka
MPM: Maputo
MRU : Mauritius
MSU : Maseru
MTS : Manzini
SEZ: Seychelles
TNR : Antananarivo
WDH : Windhoek

Source: computed from research data

Figure 3-1 Connectivity matrix for intra-SADC network as at April 2011

For each airport the row sum, defined as the degree of a node, represents the total number of other airports that have connections with it by direct or non-stop flights. This row sum can be used to rank the airports in terms of their function in the network. For the SADC network Johannesburg airport (JNB) reflects that it is the de-facto regional hub. Three airports, Kinshasa (FIH), Manzini (MTS) and Maseru have no other link except the connection to Johannesburg.

Critics of this measure argue that the degree of a node can be misleading, because it measures only direct linkages (direct flights) (Guimera, Sales-Pardo and Amaral, 2006; Taaffe *et al,* 1996; Rodrigue *et al,* 2009). Academic researchers argue that accessibility performance measures should reflect the fact that it is possible to move from one node to another, even if no direct link

between them exists, by travelling indirectly via other nodes (third airports). It is for this reason that other studies have proposed measures of accessibility of airports that include indirect connections. (Kuby *et al,* 2009; Rodrigue *et al,* 2009; Taaffe *et al,* 1996) suggest the computation of a Total Accessibility Matrix (T-Matrix)

3.3.2.2 T-Matrix

This technique involves matrix multiplication where the connectivity matrix C^1 is powered (multiplied by itself) to its diameter or until all airports register a connection (no cell has a zero). Total accessibility measures are then obtained by adding all the connectivity matrices obtained from the matrix multiplication procedure. In the case of the SADC network where the network diameter is 4 the total accessibility is the sum of the connection matrix C^1 and all the matrices that enumerate direct and multistep paths between the airports in the SADC network (i.e. $\mathbf{C^1 + C^2 + C^3 + C^4)}$. Summing across the rows indicates the number of ways node '$\boldsymbol{i}$' can reach all nodes in the network. The T-Matrix as presented in Figure 3.2 enables the calculation of both the total accessibility of an airport and for the entire network.

	DAR	FIH	GBE	HRE	JNB	LAD	LLW	LUN	MPM	MRU	MSU	MTS	SEZ	TNR	WDH	Nodal Index
DAR	0	28	63	86	133	82	76	94	54	38	28	28	34	34	41	819
FIH	28	0	26	33	43	31	30	36	24	19	15	15	18	18	20	356
GBE	63	26	0	76	112	74	70	84	47	34	26	26	31	31	37	737
HRE	86	33	76	0	166	95	91	123	68	45	33	33	40	40	53	982
JNB	133	43	112	166	0	156	140	191	102	79	43	43	62	62	74	1,406
LAD	82	31	74	95	156	0	87	105	60	43	31	31	38	38	47	918
LLW	76	30	70	91	140	87	0	104	59	40	30	30	36	36	44	873
LUN	94	36	84	123	191	105	104	0	79	50	36	36	44	44	59	1,085
MPM	54	24	47	68	102	60	59	79	0	32	24	24	29	29	38	669
MRU	38	19	34	45	79	43	40	50	32	0	19	19	27	27	26	498
MSU	28	15	26	33	43	31	30	36	24	19	0	15	18	18	20	356
MTS	28	15	26	33	43	31	30	36	24	19	15	0	18	18	20	356
SEZ	34	18	31	40	62	38	36	44	29	27	18	18	0	25	24	444
TNR	34	18	31	40	62	38	36	44	29	27	18	18	25	0	24	444
WDH	41	20	37	53	74	47	44	59	38	26	20	20	24	24	0	527
Full network Index																10,470

Source: Calculated from research data

Figure 3-2 T-Matrix for intra-SADC air transport network as at April 2011

The results show that with the exception of Lusaka (LUN) with an accessibility index above 1,000 as is the case with Johannesburg,) the rest have low accessibility indices.

There have been arguments that accessibility measures obtained using this technique should discount indirect routes relative to direct routes. Garrison (1960) introduced a scalar weighting system that accounts for attenuation by assigning lower weights to paths with more links. The other major criticism of the T-matrix lies in the fact that it includes redundant routes with meaningless back and forth loops. Various studies have suggested accessibility measures that eliminate redundancies. One such measure is the Shimbel index or D-matrix.

3.3.2.3 Shimbel Index

In a defined network with a fixed number of nodes, the Shimbel index measures the minimum number of paths that are necessary to connect one node 'i' to every other node 'j' in that network (Taaffe et al, 1996; Rodrigue et al, 2009). This it does by generating a D^1 matrix that records only the number of links in the shortest topological path between any pair of nodes, and ignoring all paths with more links. The calculation of the index involves matrix manipulation as is the case with the Total accessibility index. The connectivity matrices $\mathbf{C^1}$ to $\mathbf{C^n}$ are used to construct the Shimbel Distance Matrix (D-Matrix). The first matrix $\mathbf{D^1}$ is an adaptation of C^1 where a 1 indicates the presence of direct link and 0 otherwise. Using the $\mathbf{D^1}$ matrix as the building block and maintaining the values of 1 representing direct connections, $\mathbf{D^2}$ records a 2 in those cells that had zero values in $\mathbf{C^1}$ but registered connections for the first time in $\mathbf{C^2}$. Keeping the 1 and 2 values expressing direct and one stop connections in $\mathbf{D^2}$ cells**,** $\mathbf{D^3}$ is constructed by recording the value 3 on those cells registering connections for the first time in $\mathbf{C^3}$**.** The procedure is repeated until all the connectivity matrices that correspond with the network diameter have been accounted for. Given the fact that the D-Matrix eliminates redundancies the network diameter of SADC is 2. Summing across the rows of the D matrix, as is shown in Figure 3-3, yields the total number of links that are required to move from a node 'i' to all other nodes in the network. The index in air transport provides a measure on the speed and ease with which passengers can travel from one airport to another. With 14 as the shortest possible steps needed to move from one airport to every other airport, indexes' ranging from 22 for Lusaka and 27 for Kinshasa tells a story of poor accessibility of airports.

	DAR	FIH	GBE	HRE	JNB	LAD	LLW	LUN	MPM	MRU	MSU	MTS	SEZ	TNR	WDH	Nodal Index
DAR	0	2	2	2	1	2	1	1	1	2	2	2	2	2	2	24
FIH	2	0	2	2	1	2	2	2	2	2	2	2	2	2	2	27
GBE	2	2	0	1	1	2	2	1	2	2	2	2	2	2	2	25
HRE	2	2	1	0	1	1	1	1	2	2	2	2	2	2	2	23
JNB	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	14
LAD	2	2	2	1	1	0	2	1	1	2	2	2	2	2	1	23
LLW	1	2	2	1	1	2	0	1	2	2	2	2	2	2	2	24
LUN	1	2	1	1	1	1	1	0	2	2	2	2	2	2	2	22
MPM	1	2	2	2	1	1	2	2	0	2	2	2	2	2	2	25
MRU	2	2	2	2	1	2	2	2	2	0	2	2	1	1	2	25
MSU	2	2	2	2	1	2	2	2	2	2	0	2	2	2	2	27
MTS	2	2	2	2	1	2	2	2	2	2	2	0	2	2	2	27
SEZ	2	2	2	2	1	2	2	2	2	1	2	2	0	2	2	26
TNR	2	2	2	2	1	2	2	2	2	1	2	2	2	0	2	26
WDH	2	2	2	2	1	1	2	2	2	2	2	2	2	2	0	26
Full Network Shimbel Index (steps)																364

Source: Calculated from research data

Figure 3-3 D-matrix for intra-SADC air transport network as at April 2011

One drawback highlighted by literature on this index, is the fact that it is obtained from the presence or absence of a direct flight (Bowen, 2002; Chou, 1993; Malighetti et al, 2008). The binary nature of the data used in calculating the index overlooks the density of network links in terms of flight frequencies and seat or cargo capacity (Bowen, 2002). A route with a few dozen seats per week has the same value in the adjacency matrix as a route with thousands of seats. Researchers suggest such measures should be able to indicate accessibility to other nodes in terms of the actual length. One such measure of accessibility that takes account of length of links is the Value Graph or L-Matrix

3.3.2.4 Value Graph/ L-Matrix

The Value Graph, as is the case in the D-matrix measures the shortest topological distance between airports. The difference is that the L-matrix uses actual lengths. The procedure followed in constructing the L-Matrix uses the

same concepts as the D-matrix but the method for calculating shortest path lengths is different. $\mathbf{L^1}$ is an adaptation of $\mathbf{C^1}$ with the difference being the fact that in place of binary representation, the value graph cells reflects distance. In place of a 1 is the actual distance and ∞ (infinity) replaces 0. $\mathbf{L^2}$ is generated using $\mathbf{L^1}$ as the building block and maintaining the distance recorded on direct connections. For each pair of nodes with one step connections, the shortest path is picked from comparing the lengths of all possible paths. Ignoring all paths with longer distances, the shortest distances replaces the ∞ values. As is the case with the D-Matrix, the L-Matrix corresponds with the diameter of the network. Summing across the rows of L matrix as is shown in Figure 3-4 yields the total distance needed to travel from a node 'i' to all other nodes in the network.

	DAR	FIH	GBE	HRE	JNB	LAD	LLW	LUN	MPM	MRU	MSU	MTS	SEZ	TNR	WDH	Nodal Index
DAR	0	5,244	2,571	1,515	2,449	3,310	990	1,516	2,230	5,515	2,813	2,764	6,213	4,594	3,638	**45,362**
FIH	5,244	0	3,073	3,765	2,795	5,286	4,277	3,999	3,238	5,861	3,159	3,110	6,559	4,940	3,984	**59,290**
GBE	2,571	3,073	0	924	278	2,769	1,449	1,055	721	3,344	642	593	4,042	2,423	1,467	**25,351**
HRE	1,515	3,765	924	0	970	2,166	525	397	1,413	4,036	1,334	1,285	4,734	3,115	2,159	**28,338**
JNB	2,449	2,795	278	970	0	2,491	1,482	1,204	443	3,066	364	315	3,764	2,145	1,189	**22,955**
LAD	3,310	5,286	2,769	2,166	2,491	0	2,393	1,794	2,784	5,557	2,855	2,806	6,255	4,636	1,579	**46,681**
LLW	990	4,277	1,449	525	1,482	2,393	0	599	1,925	4,548	1,846	1,797	5,246	3,627	2,671	**33,375**
LUN	1,516	3,999	1,055	397	1,204	1,794	599	0	1,647	4,270	1,568	1,519	4,968	3,349	2,393	**30,278**
MPM	2,230	3,238	721	1,413	443	2,784	1,925	1,647	0	3,509	807	758	4,207	2,588	1,632	**27,902**
MRU	5,515	5,861	3,344	4,036	3,066	5,557	4,548	4,270	3,509	0	3,430	3,381	1,741	1,059	4,255	**53,572**
MSU	2,813	3,159	642	1,334	364	2,855	1,846	1,568	807	3,430	0	679	4,128	2,509	1,553	**27,687**
MTS	2,764	3,110	593	1,285	315	2,806	1,797	1,519	758	3,381	679	0	4,079	2,460	1,504	**27,050**
SEZ	6,213	6,559	4,042	4,734	3,764	6,255	5,246	4,968	4,207	1,741	4,128	4,079	0	2,800	4,953	**63,689**
TNR	4,594	4,940	2,423	3,115	2,145	4,636	3,627	3,349	2,588	1,059	2,509	2,460	2,800	0	3,334	**43,579**
WDH	3,638	3,984	1,467	2,159	1,189	1,579	2,671	2,393	1,632	4,255	1,553	1,504	4,953	3,334	0	**36,311**
Full network measure (Shortest path length in kilometres)																**571,420**

Figure 3-4 L-matrix for intra-SADC air transport network as at April 2011

3.3.3 Measures of network circuity

Measures of circuity evaluate how well an air transport network overcomes distance (Rodrigue et al, 2009). Several methods measure the degree of circuity in a network by comparing the actual length of links to the "as the crow flies" (straight line) distance between the start and end of a route or an airport. Kansky (1989) developed a measure of circuity for individual nodes; based on the difference between the Euclidean distances what he termed desired line and the network's shortest paths from node 'i' to every other node 'j'.

Table 3-5 Graph theoretic measures for circuity

Network Measure	Formula	Meaning	Interpretation
Degree of Circuity	$dc = \frac{\sum_{i=1}^{n} (E-D)^2}{v}$ Where **E** is the existing route in miles/kms **D** is the length of a desire line in miles/kms **D** represents the shortest imaginary air distance between two airports)	This index measures the directness of travel from a given airport in a network	The higher the degree the less connected an airport is. The full network measure is computed by aggregating the individual airport measures.

Modern graph theory proponents suggest the route factor or detour index to compute the degree of circuity (Levinson and El-Geneidy, 2007; Rodrigue et al, 2009; Barthélemy, 2011). The detour index is computed as a ratio of the actual over the geodetic distance for each link. The computation is illustrated by Figure 3-5.

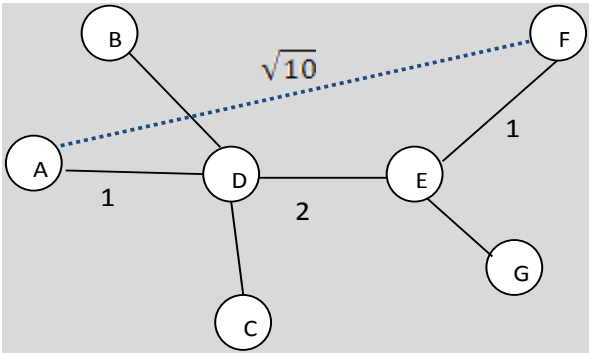


Figure 3-5 Computation of detour index

The geodistance is "as the crow flies" distance between two airports. The actual total route distance is calculated from the sum of lengths of segments which belong to the shortest path between the airports. Using Figure 3-5 the detour index would be = $\frac{4}{\sqrt{10}} \approx 1.265$

This ratio is always greater than one and the closer a network is close to one, the more efficient the network. Ratios of 1.0 indicate a straight line, whereas ratios greater than 1.0 indicate circuity. The degree of circuity for the entire network can be computed either as the average of the route factor ratios for all links, or as the ratio of the sums. In either case, higher numbers generally result from poor connectivity.

3.3.4 Measures of network concentration

Market concentration indicators serve to indicate the dominance of firms in a market. Various measures have been developed to approximate market power in various industries. Bergeijk (1996) suggests two, the four-firm concentration ratio (C4) and the HHI. The C4 ratio represents the market share of the four largest firms in an industry whereas the HHI is the sum of the squared market shares of all firms in the industry. The HHI is a widely accepted method used to measure the amount of concentration in the airline industry is (Vasigh et al, 2008; Holloway, 2008; Cento, 2008). The index is calculated by squaring the market shares of each airline competing on a city-pair and then summing the resulting figures (**$S^2 + S^2 + ...N^2$**)

Where S is the market share and N is the number of the participants on a city pair).

The number, size and capacity of carriers on a city-pair determine the magnitude of the ratio. On routes characterised by many competitors of similar strength and market share, the HHI is hypothesised to approach zero. The index increases as the number of competitors decreases and competitive strength differs. The HHI therefore ranges from a number approaching zero where there are many competitors to l0,000 (in the case of a pure monopoly) The U.S. Department of Justice, according to Holloway (2008) and Vasigh et al (2008) considers results of an HHI below 1,000 to indicate a market that is less concentrated. Results between 1,000 and 1,800 imply moderate concentration and those above 1,800 to suggest high concentration.

It should be noted however that concentration ratios lower than 1,800 are not a common phenomenon on many air transport markets due to the dictates of airline economics of demand and supply. The economic reality in the airline industry is that there are few city-pairs with sufficient demand to sustain many carriers.

3.3.5 Graph theoretic measures adopted by this study

This research adopted basic graph theoretic measures based on their usefulness in comparing networks of different sizes and at different times.

3.3.5.1 Connectivity

This study considered those connectivity measures that are transformed in such a way that the upper and lower limits take the same value for different networks. It is for this reason that indices expressed in the form of ratios and are capable of being compared across different types of network structures were utilised. The cyclomatic number and the diameter, which are absolute numbers, were therefore not relevant for the purpose of this study.

The cyclomatic number (μ) is an arithmetic comparison between number of routes and number of airports in a network. It therefore depends upon the number of vertices and edges only. A larger network in spite of its many limitations and inadequacies may have a larger value. The diameter (δ) on the other hand, measures the minimum number of routes that must be traversed in order to move between the two airports that are farthest apart. This measure is rendered meaningless by the development of regional hubs.

Although ratio measures were considered useful common yardsticks for comparison between networks the study did not pick all the indices. No drawbacks were identifying with those indices conveying the relationship between airports and routes (i.e. alpha (**α**), beta (**β**), gamma (**γ**)). For those ratio measures that represent the relationship between the total mileage of the network and its airports and routes (i.e. eta (**η**), pi (**π**), iota (**ι**), theta (**θ**)), three were not utilised by this research. These are eta (**η**), pi (**π**) and iota (**ι**).

As the ratio between total kilometres of the route network and the observed number of routes, eta (**η**) is a measure that depends on the location of specific airports on a network. A network with airports that are close to each other will have a lower value of eta (**η**), when compared to a network with airports distant to each other. Adding a new airport would have the effect of reducing average route length. Given the fact that the study is using defined networks with a fixed number of airports, theta (**θ**), a measure of the average length per airport, was considered a proxy and a superior measure to eta (**η**).

The formula for pi (**π**) has the air transport network diameter as its denominator. The index was therefore not considered for the same reasons that rendered network diameter meaningless for network evaluation. The iota (ι) calculation is based on the intuitive assumption that the structure of an air transport network is a reflection of the network‘s traffic flow pattern. In the absence of data on traffic flow, as was the case with this research, the measure does not facilitate meaningful comparison as the denominator represents the sum of the airports,

weighted in such a way that an airport gets a weight of two when it is the third and higher order intersection.

Four indices; alpha (α), beta (β), gamma (γ) and theta (θ) were therefore adopted as indicators for examining connectivity. The advantage of using alpha (α) as Rodrigue et al (2009) suggest is that it expresses the level of connectivity independently of the number of nodes in a network. Beta (β) is a helpful indicator of linkage intensity (Ivy, 1995). The study considered gamma (γ) an efficient value to measure the progression of a network in time (Rodrigue *et al* 2009). The average distance per network node, a measure presented by theta (θ) is a useful measure of network progression over time.

3.3.5.2 Accessibility

The study settled on those accessibility measures that facilitated evaluation and comparison of the entire network. In addition only those measures that eliminate redundancies were utilised. It is for this reason that measures of individual elements of the network and the T-Matrix were not used.

Accessibility was therefore examined through two indices; the Shimbel Index and Value Graph. Despite its limitations, the Shimbel index, a measure of accessibility that various researchers (Bowen, 2002; Chou, 1993; Malighetti et al, 2008) agree is intentionally simple is adopted for investigating the SADC network. The value graph was considered a useful measure that adds value to the Shimbel index shortest path by attaching actual distance to those paths.

3.3.5.3 Circuity

Of the two measures of network circuity that were at the disposal of this research, the degree of circuity was considered the appropriate measure for examining how well the intra-SADC network overcomes the friction of distance. The computation of the two indices is based on the same principles with degree of circuity proving better insight as it shows the actual distance.

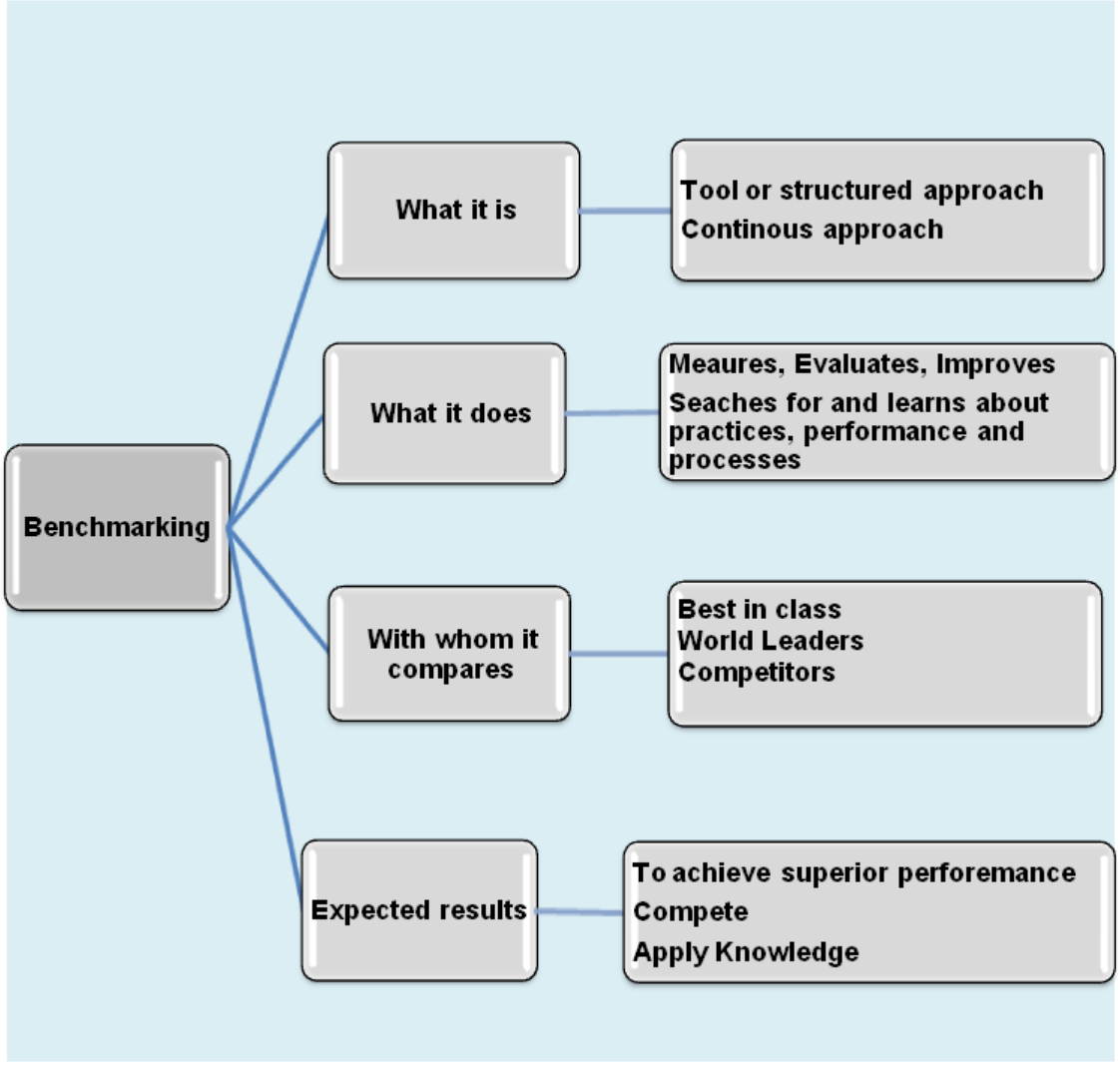
3.3.5.4 Market concentration

The HHI formed the basis on which market concentration was determined. Given the nature of the city-pairs that were the subject of this study, few routes would have yielded more than four carriers to warrant the use of the C4 ratio.

3.4 Benchmarking

Benchmarking, whose origins is cited as Total Quality Management (TQM) in the 1940s (Moriarty, 2011) has had a variety of definitions from both academics and practitioners (Amaral and Sousa, 2009). Camp (1989) describes benchmarking as “the search for industry best practices that will lead to superior performance.” Published literature concur that benchmarking is about performance evaluation and improvements achieved through comparison with other organisations recognised as the best within the area (Ahmed and Rafiq 1998; Kulmala, 1998; Bhutta and Huq, 1999; Carpinetti and de Melo, 2002). Moriarty and Smallman (2009) describe benchmarking as “an exemplar driven teleological process operating within an organisation with the objective of intentionally changing the existing state of affairs into a superior state of affairs.”

Describing benchmarking as a tool used for conducting diagnostic analysis and directing improvement efforts, Amaral and Sousa (2009) summarise the various definitions as illustrated by Figure 3-6.



Source: Compiled from various sources (e.g. Amaral and Sousa 2009, Bhutta and Huq, 1999)

Figure 3-6 Definition of benchmarking

Benchmarking can therefore be summarised as a structured way of looking outside an organisation to identify, analyse and adopt the best practice in or outside one's industry (Johnson, Scholes and Whittington, 2011). The importance of benchmarking is that it is a tool used to improve performance by understanding methods and practices required to achieve better performance. The process facilitates learning from leaders and incorporating best practices. The real benefit of benchmarking comes from understanding the practices that permit superior performance.

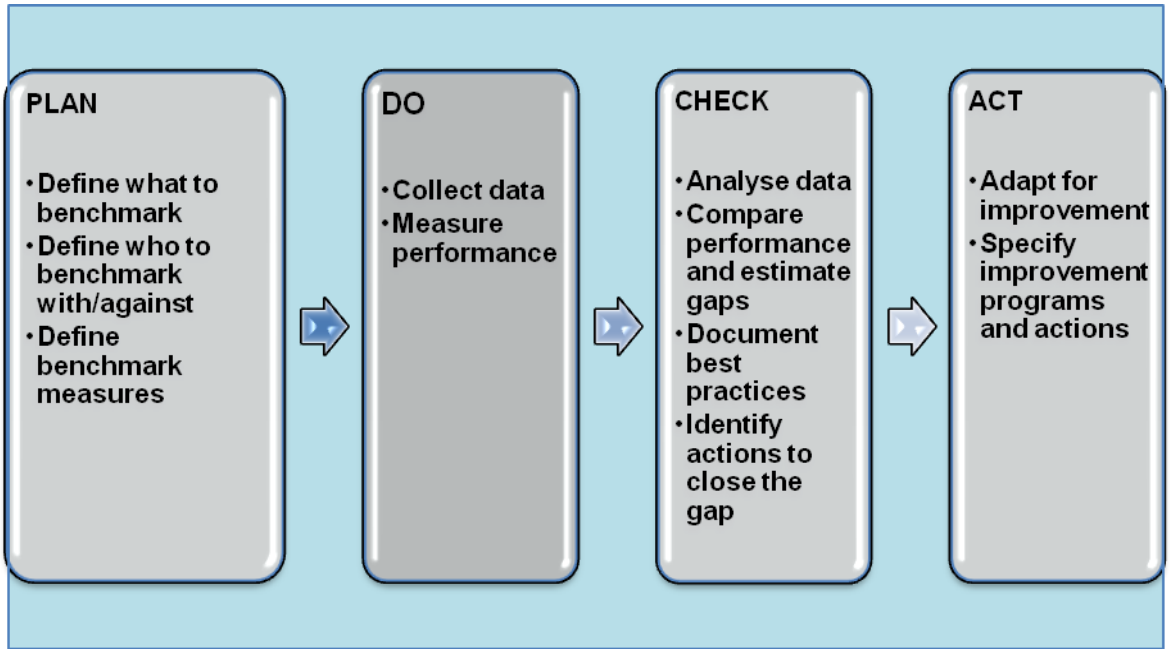
Benchmarking is nonetheless not without flaws. Critics of this technique assert that it only offers surface comparisons (Camp, 1989; Johnson *et al*, 2011). They argue that even though benchmarking compares inputs (resources) and outputs or outcomes, it does not identify the reasons for the good or poor performance of organisations since the process does not compare competences directly.

3.4.1 Benchmarking process

Various studies and empirical results suggest that for one to complete a benchmarking exercise, one has to develop and adopt chronological stages with varying length. Kulmala (1999) identified six chronological phases in benchmarking:-

- Identifying what to benchmark
- Choosing partners for that
- Gathering data
- Analysing and identifying gaps as well as possible solutions
- Choosing the best practices
- Applying them

Moriarty (2011) notes that management literature on benchmarking has no single standard benchmarking framework; what they have in common is what he terms Plan, Do, Check, and Act (PDCA) framework as presented in Figure 3-7.



Source: adapted from various sources; (e.g. Moriarty, 2011; Kulmala, 1999)

Figure 3-7 Benchmarking process

3.4.2 Planning benchmarking

There are a number of different approaches to benchmarking. Kyro (2003) proposes an integrated matrix with two dimensions when planning a benchmarking exercise. The two dimensions as is shown in Table 3-6 relate to what is benchmarked and what the comparison is being made against.

Table 3-6 Benchmarking dimensions

What is benchmarked	Against what to benchmark			
	Internal	**Competitor**	**Functional**	**Generic**
Performance	Medium	High	Medium	Low
Processes	Medium	Low	High	High
Strategic	Low	High	Low	Low

Adapted from Kyrö (2003)

Each combination is evaluated as low, medium or high in accordance with the results they produce. The matrix suggests that if the target for benchmarking is performance, this combines best with competitor benchmarking. Process benchmarking yield best results when benchmarked against functional and generic partners. Strategic benchmarking yield best results if benchmarked against competitors.

3.4.3 Defining what to benchmark

The target for benchmarking in an organisation could be the performance of the organisation, its processes or strategy (Camp, 1999). He further argues that the narrower the focus of what is being benchmarked the higher the success for the benchmarking exercise.

3.4.3.1 Performance benchmarking

Performance benchmarking is defined as a comparison of the performance of an organisation for the purpose of determining how good an organisation is as compared to others (Bhutta and Huq, 1999). The performance of an air transport system in moving traffic is judged by how well it performs that function compared to other networks. The concept has been utilised in airport performance benchmarking studies (Graham, 2000). Paleari *et al,* (2010) benchmarks the performance of three air transport networks in developed countries to establish the networks that served customers better.

3.4.3.2 Process benchmarking

Delpachitra and Beal (2002) describe process benchmarking as the analysis of discrete work processes with the aim of identifying the most effective operating practices from organisations that perform similar work. The aim is to improve the processes of the organisation. In air transport networks the processes that would be benchmarked would be the efficiency with which traffic (passengers, cargo and information) flows are handled at airports. This would require access to detailed information which might not be readily available.

3.4.3.3 Strategic benchmarking

Strategic benchmarking is needed when an organisation aims to change its strategic direction and the comparison relates to how the strategy is made. In air transport, the restructuring, or liberalisation, of air transport networks that has engulfed the world has been a replication of those employed by the U.S. and the E.U. The strategies used by policy makers in the U.S. and the EU have informed the crafting of air transport liberalisation and open skies policies of many regions.

3.4.4 Benchmarking partner

The partner refers to the specific organisations benchmarking is taking place against/with. The requirement is that these be organisations where best practice is known to have occurred. Moriarty (2011) refers to these as the exemplar. Various studies suggest that there is no prescriptive way to determine who to benchmark. The overall methodology suggested by Camp (1989) is that one;

- Develops a candidate list using any and all readily available information and some preliminary research
- Reduce the list to a target number

Benchmarking partners can be internal or external (Anand and Kodali, 2008; Camp, 1989). Partners could be other units of the same organisation (internal), competitors, own industry or technology (functional) and best practice regardless of industry.

3.4.4.1 Internal Benchmarking

This entails comparison among similar operations within one's organisation. Moriarty (2011) argues that the starting point on whom to benchmark should always be internal. Johnson *et al* (2011) observe that it is common for organisations to engage in historical benchmarking where they consider their performance in relation to previous years in order to identify any significant changes. In the case of this study, the starting point could have been the

historical performance of the SADC network since July 1998 over the last twelve years. Published literature advises that the danger with this is that it can lead to complacency since it is the rate of improvement compared to competitors that is important. Given the fact that SADC is one of the eight regional economic communities forming the building blocks of the AEC the other potential candidates for internal benchmarking could have been the other seven regional economic groups. The drawback with this approach is that the candidate benchmarking targets may not represent the best practice.

3.4.4.2 Competitor benchmarking

This involves comparisons to the best of the direct competitors. Johnson *et al* (2011) suggest that insight about performance can be gleaned by looking at the comparative performance of other organisations in the same industry. Literature on benchmarking recommends competitive comparison to the best of the direct competitors in the industry as the preferred approach. This is because an organisation will want to know where it stands when compared to others in the industry. These industry norms compare the performance of organisations in the same industry or sector against a set of performance indicators. An example is the IATA ethics and Airport Performance Indicator. In Higher Education the Financial Times has used league tables to compare universities worldwide. In the case of this study competitor benchmarking would entail comparing the intra-SADC network to other developing regions of ASEAN, CARICOM and MERCOSUR competing for airborne trade, investment and international tourism flows.

The lamentation about competitor benchmarking according Johnson *et al* (2008) and Camp (1989) is that whilst it makes sense to compare like with like, an overriding danger of industry norm comparisons is that the whole industry may be performing badly and losing out competitively to other industries that can satisfy customer needs in different ways. The other organisations therefore might not have practices worth emulating. The argument therefore is a benchmarking exercise should probably look wider than a particular industry or sector.

Empirical results from various studies however suggest that benchmarking within the same industry is the best as it will help identify competitive gap and the comparison will be like for like.

3.4.4.3 Functional benchmarking

Both academic researchers and practitioners agree that benchmarking can look outside the industry for innovative ideas. Functional benchmarking involves comparison of methods to companies with similar processes in the same function outside an industry. The process entails comparing an organisation's processes against best in class wherever that is found. Johnson *et al* (2008) point out that British Airways improved aircraft maintenance, refuelling and turnaround time by studying the process surrounding Formula One Grand Prix motor racing pit stops. Literature on benchmarking suggests that comparisons with organisations with similar process but outside the industry have the potential for uncovering best practices. This study could have therefore looked at other networks whose function is also to move traffic. This could have been surface transport and communication networks. Air transportation is not the only area that has been restructured through liberalisation in SADC and worldwide. Trade, financial services sector and communication have also been restructured. The limitation of this approach is that the focus of this study was on strategy execution.

3.4.4.4 Generic benchmarking

Generic benchmarking entails comparison of an organisation's performance with best–in-class performance across industries or sectors. The technique has been used by both practitioners and academic scholars. IATA sponsored studies on air transport liberalisation utilised generic benchmarking to establish the reason liberalisation was successful in some industries and a failure in others to recommend specific actions for air transport reforms (IATA, 2012).

3.4.5 The benchmarking approach adopted by this study

The bench marker or the anomalar in this study is a regional economic bloc comprising of fifteen developing countries at various stages of economic development.

3.4.5.1 The target for benchmarking

The target for benchmarking is liberalisation strategy execution that creates the necessary conditions for the development of integrated and demand driven regional air transport networks.

3.4.5.2 Selection of benchmarking partners

The internal and external benchmarking decision tilted in favour of the latter. The intra-SADC air service network could have been benchmarked to another regional economic community that is implementing the YD, but no exemplar region was identified from the available literature on the implementation of YD.

Of the external exemplar organisations that were identified, benchmarking partners were chosen on the basis that they had similar geographical definition i.e. regional economic communities. Because socio-economic indicators and demographic indicators are a major driver in air travel demand, benchmarking partners chosen were those that had similar characteristics as the anomalar organisation. The reason for this decision is that whatever is observed as better practice in the exemplar networks is easily transferable to the intra-SADC network. As a result the EU, although cited as the role model in successful implementation of air transport reforms (Holloway, 2008), could not be used as a benchmarking partner for the intra-SADC network. From a list of developing country regions that included CARICOM, ASEAN and MERCOSUR, the study settled on the latter two.

Whilst this research could also have used similar networks that have undergone effective restructuring such as communication, the research opted for exemplar organisations in the airline industry to facilitate comparison.

3.4.6 Characteristics of the selected benchmarking partners

3.4.6.1 ASEAN

Established on 8 August 1967, the ASEAN comprises of Brunei, Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam, (ASEAN, 2009). Although the ASEAN, presented in Figure 3-8, is larger than SADC (in terms of population), richer (in terms of GDP) and the airline network larger than the one obtaining in SADC, the region shares the following similar characteristics:-

a. With the exception of Brunei and Singapore, member countries in both regions are structurally diverse and at varying stages of economic development.

b. Aviation policies in member states of both regions vary. Some have policies that are more liberal whilst some have maintained traditional restrictions on their aviation markets (Forsyth, King and Rodolfo, 2006).

c. The region consists of a mixture of island chains and mainland states that are reachable by both sea and air transport. Air transport is however the most practical mode of transport for the vast majority of the region's travel needs (Nikomborirak, 2005)

ASEAN member states as at April 2011

Demographic and economic indicators

Country	Population "millions"	GDP (constant 2000 US$) "billions"	GNI per capita PPP
Brunei	0.40	7	n/a
Cambodia	14.14	8	2,080
Indonesia	239.87	274	4,200
Lao PDR	6.20	3	2,440
Malaysia	28.40	147	14,220
Myanmar	47.96	n/a	1,950
Philippines	93.26	129	3,980
Singapore	5.08	165	55,790
Thailand	69.12	187	8,190
Vietnam	86.93	63	3,070
Total	**591.36**	**983**	

Source: based on ASEAN Secretariat, ACI statistics, World Bank Development indicators (2011) and Google Circle Mapper (copyright © Karl L. Swartz.)

Figure 3-8 ASEAN region and its economic indicators

Efforts towards air transport liberalisation in ASEAN are traceable to a series of consecutive plans of actions on the transport sector whose foundation lay in the ASEAN Plan of Actions in transport and Communications 1994-1996 (ASEAN, 2010). Successor plans of actions for the periods 1996-1998 and 1999-2004 culminated into the ASEAN Transport Action Plan (ATAP) 2005-2010; a regional agreement that specifically addressed intra-ASEAN air transport liberalisation and as is the case in SADC envisaged open skies policy on "a staged and progressive basis." Empirical evidence in published literature on ASEAN civil aviation reforms reflects that the intra-regional air transport network has witnessed significant transformation (Bowen, 2002; Holloway 2008). The

region is home to some of the best performing airlines in the world such as Singapore Airlines and Thai Airways. The region has also witnessed the emergence of strong low cost airlines such as Air Asia.

3.4.6.2 MERCOSUR

Created in March 1991, the MERCOSUR, presented in Figure 3-9, comprises four full members and six associate states. The member states are Argentina, Brazil, Paraguay and Uruguay. The associates are Bolivia, Chile, Colombia, Ecuador, Peru and Venezuela. Four of the associates (Bolivia, Colombia, Ecuador and Peru) are also members of the Andean community, which in 1991 had also reached an agreement on integration of air transport amongst the four member states.

MERCOSUR member states as at April 2011

Demographic and economic indicators

Country	Population	GDP (constant 2000 US$)	GNI per capita
	"millions"	"billions"	
Argentina	40.4	434	15,570
Bolivia	9.9	12	4,640
Brazil	194.9	916	11,000
Chile	17.1	108	14,640
Colombia	46.3	150	9,060
Ecuador	14.5	25	7,880
Paraguay	6.5	10	5,080
Peru	29.1	92	8,930
Uruguay	3.4	31	1,620
Venezuela	28.8	159	12,150
Total	391	1,937	

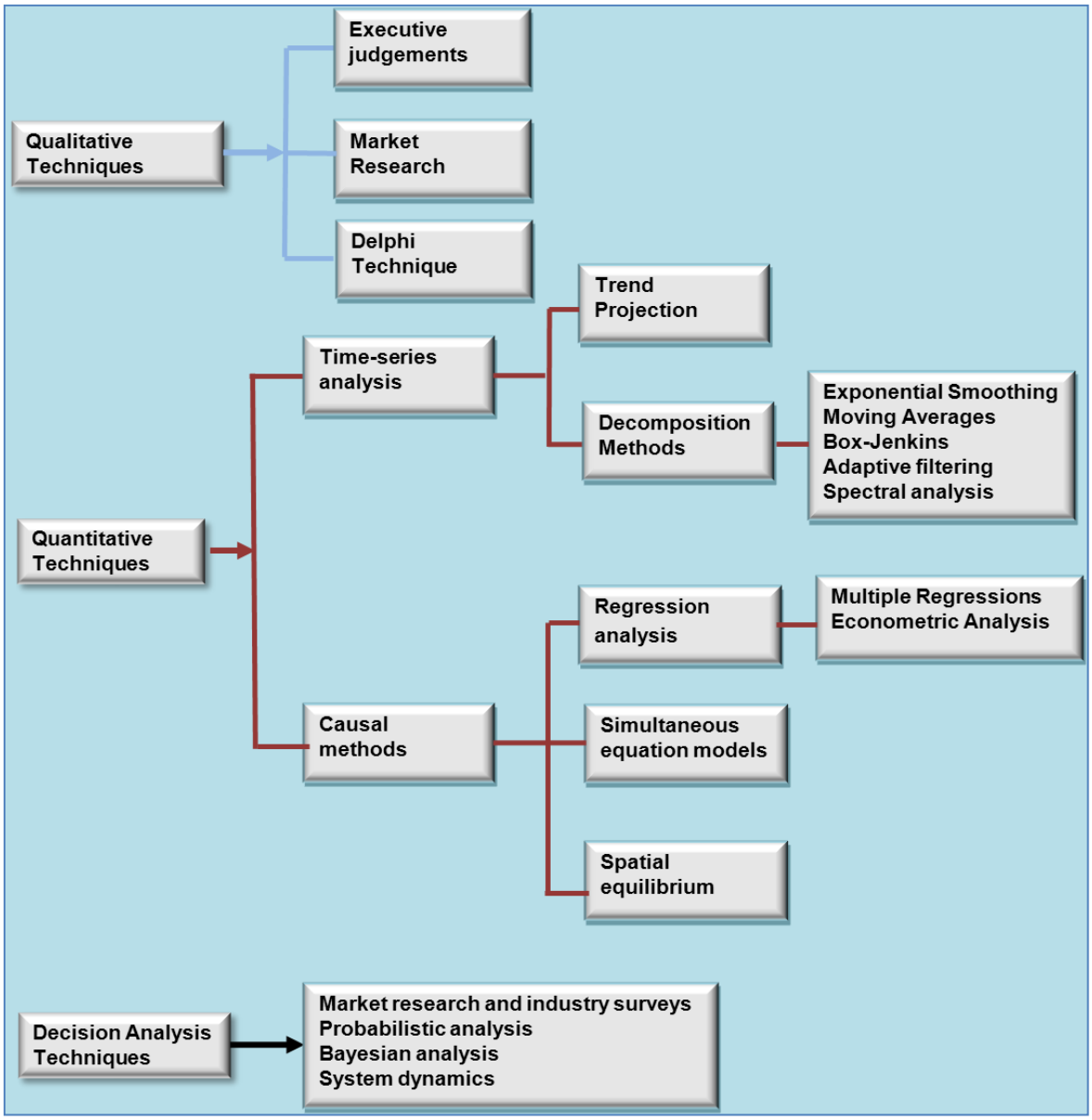
Source: based on MERCOSUR Secretariat, ACI statistics, World Bank Development indicators (2011) and Google Circle Mapper (copyright © Karl L. Swartz.)

Figure 3-9 MERCOSUR region and its economic indicators

Although Brazil and Argentina dominate the regional economy of MERCOSUR, the member states are heterogeneous in size and economic structure as is the case with SADC. The main modes of intra-MERCOSUR travel are road and air transport. The region is characterised by long distances with air transport the most convenient mode of transport for effective regional integration. The region is implementing an air transport liberalisation agreement; (the Fortaleza Agreement), which was signed in 1997 and became effective in April 1999 (ICAO, 2009). Empirical evidence suggests that the Fortaleza Agreement has made headway in opening up fifth freedoms services in MERCOSUR (Holloway, 2008).

3.5 Techniques for estimating air travel demand

Forecasting demand for air transport is a subject that occupies a prominent place in transportation literature (Kanafani, 1983). Transport economics theory and empirical studies investigating air transport demand have contributed to the development of numerous methods for estimating air traffic demand. The techniques differ considerably in their usefulness and sophistication (ICAO, 2006). They range from purely intuitive or judgemental approaches to highly structured and complex quantitative methods including econometric and simultaneous equation models (Doganis, 2002; ICAO, 2006; Greene, 2005). The various methods vary in their strengths and weaknesses, as well as in their data requirements. The ultimate test is whether or not a technique is capable of predicting potential demand fairly accurately. ICAO places these techniques into three broad categories of qualitative, quantitative, and decision analysis as presented in Figure 3-10.



Source: adapted from ICAO Manual on Air Traffic Forecasting page I-2

Figure 3-10 Techniques for analysing demand for air transport

3.5.1 Qualitative techniques for estimating air travel demand

The use of qualitative techniques in air transport demand estimation is characterised by intuition, and the judgement and experience of aviation experts and managers. The qualitative methods generally used in air travel demand forecasting are executive judgements, market research and Delphi techniques (Doganis, 2002).

With executive judgements, the demand estimates are based on the consolidated opinion of a small group of airline managers (normally area managers) with intimate knowledge of the historical demand patterns on the specific routes for which estimates are being sought. Their knowledge and experience with the city-pairs forms the basis on which the analysis is made. Market research based estimates are normally obtained from customer surveys which involves interviewing customers at airports. Delphi techniques on the other hand involve getting expert opinion from a panel of industry experts on the likely demand on routes. The composition of the panel unlike executive judgements can cut across positions in the airline industry. The estimate from each expert is circulated amongst the members and an iterative process is adopted until a consensus on demand potential is reached.

The purpose for demand forecasting techniques in this study stemmed from the need to obtain demand data on those city-pairs that did not have air services connections between them. Except for market surveys, these techniques fall short on provision of useful estimates for new routes.

3.5.2 Quantitative techniques for estimating air travel demand

Quantitative methods of forecasting air travel demand involve mathematical techniques. The techniques rely mainly on two models; time series and causal methods.

With the time series model, demand forecasts are based on a series of past observations and it is assumed that the factors that influenced the past performance will continue. When employing time series estimation methods the choice is between trend analysis and decomposition methods. Trend analysis assumes no significant changes in the factors affecting demand in the previous periods. Decompositions methods account for demand fluctuations in historical performance. Doganis (2002) observes that many airlines utilise trend analysis. He however argues that the appropriateness of using trend analysis depends heavily on stability in past developments and the confidence of the analyst that the assumptions of continuing trends is appropriate to the particular operating

environment. The applicability of time series models to existing routes as opposed to new routes ruled them out as a useful technique for this study.

Causal models use mathematical techniques to postulate precise, deterministic relationships. Dependent and independent variables are identified, a functional form is specified and a qualitative statement is made about the effects that occur when independent variables in the model changes (Greene, 1983). In air travel demand, causal methods attempt to relate changes in traffic levels to changes in selected socio-economic variables. Dependent variables in the estimation of traffic demand, in general, are historical traffic data measured in terms of passenger volumes or tonnes of cargo. The explanatory (or independent) variables are those variables that are known to have an influence on the demand for air travel.

Of the causal methods, literature advances regression and econometric analysis as the most popular methods. The advantage econometric modelling has over other forecasting techniques is the ability to produce useful forecasts on city-pairs that do not have direct air service connections. The gravity model is the most common econometric model extensively used to forecast air traffic on new routes, where there are no historical traffic data or on routes where traffic records are inadequate or non-existent (Kanafani, 1983). This econometric model is described as the gravity model due to the fact that they are derived from postulates regarding spatial interaction.

3.5.2.1 Gravity model

A variant of the gravitational law of physics, the idea behind the gravity model is that the magnitude of traffic between cities is similar to the gravitational pull between masses discovered by Newton. The assumption underlying the gravity model is that the strength of attraction between two places is determined by their economic mass and the distance between them inversely affects the strength of that attraction. The volume of traffic between cities i and j is therefore given by

$$T_{ij} = a\frac{M_i M_j}{d^2_{ij}}$$ **Equation 3-3**

Where M_i and M_j are the population of cities i and j and d_{ij} is the distance squared.

The model postulates that travel between a set of cities is directly proportional to the population of the two cities, and inversely proportional to distance squared (Verleger, 1972). Population is considered the generative variable with distance the impedance. This means that the larger the cities the more the passengers that would be travelling between them. The further away the cities, the less the number of people that would be travelling between the cities.

The simple (pure) model has been modified in various air transport studies. The number and nature of variables that have entered the gravity model as generative and impedance variables have varied over the years. Table 3-7 lists a sample of the air transport studies that have used the gravity model in both pure and modified form.

Table 3-7 Studies that have applied the gravity model in air transport		
Year	**Author**	**Explanatory variables used**
1951	D'Arcy Harvey	Population and distance
1966	Doganis	Passenger numbers at airports and distance
1968	Brown, S., Watkins, W.S.	Income, sales competition, average fare per mile, journey time per mile, number of stops, distance, phone calls, international passengers on domestic flight, competition index
1972	Verleger	Income, price, phone calls, distance, flying time
1983	Fothering	Attractiveness/populations, traffic outflow of origin, distance
1991	Kaemmerle	Population, per capita income, total personal income, per cent of employees in managerial and professional positions, distance, aircraft type
1992	Rengaraju and Thamizh	Population, percentage of employees, university degree holders, big city proximity factor, travel time ratio(travel time by rail divided by travel time by air) distance, frequency of services
1993	Russon and Riley	Income, population, highway miles distance, number of jet/propeller non-stop/connection flights, driving time minus connection flight time, distance to competing airports, political state boundary.
1995	O'Kelly et al	Nodal attraction, distance
1997	Jorge-Calderon	Population, income, proximity to hub airport, hub airport, distance, existence of body of water between cities, tourism destination, frequency, aircraft size, economy fare(not/moderately/highly discounted restricted)
2004	Shen	Nodal attraction, impedance
2005	Adler and Hashai	Population, GDP, distance(great circle and commercial)
2007	Matsumoto	Population, GDP, distance
2007	Grosche et al	Population, catchment, buying power index, GDP, distance, average travel time.
2009	Hazledine	Population, distance, GDP, language, border

Source: Grosche *et al*, 2007 and primary data

The gravity model is not without flaws. Its limitation is the lack of economic theoretical foundations (Kanafani, 1983). As explained above, the model is derived from postulates on spatial interaction not from the price-income structure that underpins many demand equations. Gravity models have

however proved to be useful empirically and have produced good results in a number of studies (Kelly, 2009). Among the seminal contributions of gravity model applications in social research was the examination of such interactions as migration between countries (Ravenstein, 1885), retail trade (Reilly, 1929), intercity rail travel (Lille, 1891) and air travel passenger volumes (Zipf, 1946; Kanafani, 1963; Doganis, 1966; Verleger, 1972).

3.5.3 Technique adopted in estimating air travel demand in SADC

Doganis (2006) observes that the requirements of a study dictate the suitability of the technique used. He recommends a formal criterion for selecting suitable forecasting technique which Table 3-8.describes.

Table 3-8 Criteria for choosing appropriate air travel estimation technique

Attribute	Qualitative methods			Time-series projections			Causal Methods	
	Executive Judgement	Market Research	Delphi	Annual Average growth	Exponential smoothing	Linear Trend	Regression Analysis	Gravity Model
Accuracy								
0 - 6 months	Good	Good	Fair/Good	Fair/Good	Good	Fair/Good	Good	Good
6 - 24 months	Fair	Good	Fair/Good	Poor/Fair	Fair/Good	Poor/Fair	Fair/Good	Fair/Good
5 years	Poor	Poor/Fair	Fair	Poor	Poor/Fair	Poor	Poor/Fair	Poor/Fair
Suitability for forecasting								
Traffic growth	Good	Good	Good	Good	Good	Good	Good	Good
Traffic reaction	Fair	Good	fair	n.a	n.a	n.a	Good	Poor
Traffic new routes	Poor	Fair	Poor	n.a	n.a	n.a	Fair	Good
Ability to identify turning points	Poor/Fair	Fair/Good	Fair/Good	Poor	Fair	Poor	Good	Poor
Ready availability of input data	Good	Poor/fair	Poor	Good	Good	Good	Poor/Fair	Fair
Days required to produce forecast	1 - 2	90+	30 - 180	1- 2	1 - 2	1- 2	30 - 90	20 -60
Cost	Very Low	Very High	Moderate	Low	Low	Low	High	High

Adapted from Doganis (2002)

The criterion suggested by Doganis (2002) is what this study relied on to assess the appropriateness of techniques for the purpose of this research. The purpose of this study was to identify new routes that would help in reducing fragmentation of air service connections in SADC. The qualitative technique that was relevant was market research. The resources and time required in using market research techniques rendered the technique an expensive option. Econometric models, particularly the gravity type presented themselves as the most suitable because of their potential to give good results on new routes. Although the gravity model is a broad-brush approach, its usefulness is that it gives an indication of potential demand on routes even if they have no current service. As has been the case with other studies, this research modified the simple gravity model to suit the unique needs of SADC.

Since no study had ever estimated demand on the intra-SADC network, the combination of market research structural or econometric models could have yielded better results. Nevertheless, the strength of this study is that it presents several important innovations over earlier studies that have examined the liberalisation of air transport in SADC (e.g. Schlumberger, 2010; SADC, 2009).

3.6 Empirical literature and research questions

This study investigates air transport liberalisation from different perspectives using variable research methods and approaches. Much attention has been devoted to the benefits of liberalisation and the pace at which liberalisation has progressed within SADC. This section looks at the empirical evidence from previous work and how it was relevant for the needs of this project.

There is consensus in published literature that some SADC member states particularly South Africa have made significant progress in implementing liberalisation. Conclusions on the transformative effect this progress has had on the network were arrived at on the basis of traditional sized based measures; i.e. the number of routes, frequencies, seat capacity and number of airlines as indicators for network connectivity. Available evidence suggests that flight frequencies and capacity has changed significantly (SADC, 2009). The missing

link however is how these have improved the spatial structure of the network in terms of connectivity, accessibility, circuity and market concentration.

The distinction between effective and ineffective liberalisation strategy execution, lies in the quantum of liberalisation-induced network changes achieved by a region. Available literature has benchmarked results achieved by SADC against international standards with the EU used as the role model. The evidence reveals SADC's shortfalls as institutional arrangements for monitoring the implementation of the liberalisation strategy as well as regulation of airline competition (AU, 2011). Notwithstanding the strength of this approach in that one can determine the deficiencies of the SADC network in terms of international standards, best practice in developed countries may be difficult to replicate in developing countries. This is because strategy execution in developed countries is underpinned by adequate resources, better rules and excellent skills. A gap existed on how well SADC's efforts would fare when compared to other developing regions that had subjected their networks to similar reforms.

Typical observations on the factors liable for strategy failure in SADC were protectionist tendencies by member states, government interference in airline management, shortage of skills in airline management, undercapitalisation of airlines and the use of aged aircraft (Chingosho, 2005; Schlumberger, 2010). Though a rich source of evidence for the shortcomings of SADC's air transport system; the dynamic nature of the air transport industry might have brought about changes; with old issues disappearing and new problems emerging. There was therefore need for an updated position.

Although there are assertions in some studies that demand is constrained by supply restrictions on some city-pairs (SADC, 2009), there is no study that has attempted to quantify intra-SADC air travel demand patterns and to explore their implication on network design.

As noted in section 1.1.5 empirical evidence on transformative effect of air transport liberalisation suggests that not every effort has been successful.

Wannock–Smith (2008) concludes that the stage of development towards air transport liberalisation can affect the structure, organisation, and development of a network. Given the economic and political cost implications of liberalisation strategies on SADC economies, no study has attempted to assess how this could have constrained progress on implementation.

This study sought to concentrate on bridging the gap noted in empirical evidence by pursuing the following questions;

a) How good was the implementation of the liberalisation strategy?
b) How sufficient is demand to justify direct flights on those city-pairs that do not have such connections?
c) Why has SADC failed to achieve positive results between the period July 1998 and April 2011?
d) How would a demand driven network become a reality?

In addressing these questions, the only similarity this study shares with previous works is the re-examination of the factors underlying strategy implementation failure in order to get an updated position.

3.7 Conclusion

Given the paucity of relevant previous studies in this area, this study developed a conceptual framework within which the research was conducted and adopts theories and models used by researchers in other disciplines. This study employed network analysis as the conceptual framework for the research. Central to network analysis, is the abstraction of the intra-SADC network as a graph comprising of nodes connected by linkages. Graph theory, a branch of mathematics that has been used extensively in network analysis, provides the quantified measures by which the properties of connectivity, accessibility, circuity and market concentration were investigated and compared to other intra-regional networks. Strategic benchmarking, a technique within strategic management was adopted as an aid in identifying gaps in liberalisation strategy implementation in SADC. The exercise was also useful as a tool for illuminating

better practice that SADC could replicate to ensure the liberalisation strategy delivers a demand driven network. The development of the structural model that was used to estimate demand for air transport, was an extension of the approach espoused by numerous studies and the existing transport economics literature.

4 Chapter Four: Methodology

4.1 Introduction

Research projects are conceived in order that some underlying research question may be answered (Robson, 2011). In doing so, the research serves one of two purposes; to make a contribution to general knowledge and theoretical understanding or to apply findings to solving a specific existing problem. Studies aimed at making contributions to general knowledge are described as basic or pure research. Those targeted at solving specific or existing problems are referred to as applied research (Collis and Hussey, 2009). This study, whose object of attention is a real-world problem, falls within the applied research domain. Finding new knowledge to answer questions raised and offer solutions to the fragmentation of the intra-SADC air transport network located the study within the practical rather than theoretical sphere.

Research literature concurs that for any study to provide a coherent and logical route to a reliable outcome; it must be conducted systematically using appropriate methods to collect and analyse data (Saunders, Lewis and Thornhill, 2009; Hussey and Hussey, 1997; Creswell, 2009). The philosophy underpinning a study, the research strategy and the methods employed in gathering and analysing data play a pivotal role in that process(Collis and Hussey, 2009; Easterby-Smith, Thorpe and Jackson, 2008; Sekaran, 2003). This chapter serves to explain how this study was undertaken. The philosophy the study subscribed to precedes discussions on research strategy and the research method adopted by this study. The manner in which the objectives of the study were achieved, are followed by delimitations and limitations of the study.

4.2 Research philosophy

Collis and Hussey (2009) describe research philosophy as “a belief about the way in which data about a phenomenon should be gathered, analysed and used.” They propose two major research philosophies; positivism and interpretivism. What differentiate the two are their ontological and

epistemological assumptions. Ontological assumptions relate to the nature of reality. Epistemology on the other hand concerns what is accepted as valid knowledge as it relates to the relationship between the researcher and the object of their study.

4.2.1 Positivism

Positivism, whose cradle is natural sciences or scientific research, is underpinned by the belief that social reality is singular, objective, and external to the researcher (Collis and Hussey, 2009). In addition positivists are of the opinion that only phenomena that are observable and measureable can be validly regarded as knowledge. Precision, objectivity and rigour instead of subjectivity and intuitive interpretation underpin studies that adopt this approach. Under positivism, theories provide the basis of explanation, permit the anticipation of phenomena, predict their occurrence and therefore allow them to be controlled (Collis and Hussey, 2009). The use of large samples, artificial location, hypothesis testing and production of precise, objective, quantitative data are the trademarks of positivism. In addition the approach tends to produce results with high reliability but low validity and it allows results to be generalised from the sample to population. This approach is associated with quantitative methods of collection and analysis of data.

The positivist approach was relevant for the purpose of this study as the concepts of network connectivity, accessibility, circuity, market concentration and estimates of potential demand required the collection and analysis of quantitative data. Researchers caution that there is however a danger that in seeking to apply this research philosophy, issues are isolated from their context and simplified so that they bear little relevance to the real world (Saunders et al, 2009). It is for this reason that another philosophy, interpretivism emerged.

4.2.2 Interpretivism

Rooted in the social sciences, interpretivism is grounded in the belief that social reality is subjective because it is socially constructed. Unlike the positivist

approach, the focus of interpretivism is not the measurement of social phenomena but exploring its complexity with a view to gaining interpretive (inductive) understanding. Central to the interpretivists' approach is the acknowledgement that researchers affect those social phenomena they are investigating. The research methods adopted by research projects subscribing to this philosophy are those that seek to "describe, translate and otherwise come to terms with meaning" (Collis and Hussey, 2009). The distinguishing feature of interpretivism is the use of small samples, natural location setting and the focus on generating theories. In addition this approach tends to produce rich subjective qualitative data and findings with low reliability but high validity. It also allows findings to be generalised from one setting to another similar setting. This approach is typically associated with qualitative methods of gathering and analysing data.

The relevance of this approach in this research is the fact that the problems besetting SADC need to be investigated in their natural setting. This is because the problem is peculiar to the region and adopting an interpretivist approach would allow for the understanding of the dynamics present within the SADC network and in the process generate theory on air transport liberalisation in developing regions.

4.2.3 Philosophy underpinning this study

Whilst measurement was an essential element for the nature of the problem that this study was investigating, the quality and depth of data collected about the fragmentation of air service connection on a network undergoing restructuring was also vital. As highlighted in the literature review (Chapter 3), this study used graph theoretic measures to examine and propose solutions to the disintegration of the network. It also adopts causal and econometric models to investigate and answer questions on demand potential and their effect on network configuration. These two techniques belong to positivism. Understanding what SADC could have done differently in terms of implementing their liberalisation strategy, necessitated observing how other developing regions conducted their reforms

and the results they achieved. Documenting better practices that could be replicated in SADC and examining organisational weaknesses in liberalisation strategy implementation required subjective interpretation. This approach is a feature of interpretivism.

To enhance academic rigour in this research and to ensure the most efficient and effective way of collecting and analysing data for the problem under investigation, this study combines elements of the two philosophies. How the two complement each other and how the study mixed the two is discussed in the research design section.

4.3 Research strategy

Saunders et al (2009) and Robson (2011) argue that the general principle in choosing a research strategy is that it must be appropriate for the questions the research seeks to answer. The paradigm driving this study limited the choice of strategy to those methods known to produce both quantitative and qualitative data in the same study. Literature on social research has identified experiments, surveys, histories, archival analysis and case studies as strategies capable of combining positivist and interpretivist approaches in a single study (Easterby-Smith et al, 2008; Sekaran, 2003; Robson, 2011; Saunders, 2009). Yin (2009) posits that the choice for an appropriate approach is dependent on three conditions; the type of research questions posed, the extent of control an investigator has over actual behavioural events and the degree of focus on contemporary as opposed to historical events. The resolution on the method most appropriate for this study was guided by the decision criteria Yin (2009) proposed and illustrated by Table 4-1.

Table 4-1 Criteria for choosing research strategy			
Research method	**Form of research question**	**Requires control of behavioural events**	**Focuses on contemporary events**
Experiment	How, why?	Yes	Yes
Survey	Who, what, where, how many, how much?	No	Yes
Archival analysis	Who, what, where, how many, how much?	No	Yes/no
History	How, why?	No	No
Case Study	How, why?	No	Yes

Source: adapted from Yin (2009)

The uncertainties surrounding the implementation of liberalisation and the resultant fragmentation of air service connections in SADC posed the how and why questions as discussed in the literature review. The focus of the study was a contemporary phenomenon within geopolitical and socio-economic developmental context. Two methodologies were considered relevant for the purpose of the study as they addressed the “how” and “why” questions and also take into account contemporary events. These were the experimental and case study research strategies.

4.3.1 Experiments

Experiments allow researchers to identify precise relationships between variables, and the independent variable is deliberately manipulated to observe the effect on the dependent variable. Adopting this strategy in this study would have entailed identifying a causal relationship between connectedness of the network (as the dependant variable) with demand, extent of liberalisation and other events as the independent variables. With the aid of multivariate techniques such as multiple regression analysis, generalisable statements would have been deduced on the solutions to the fragmentation of services.

The advantage of this approach is that it promotes academic rigour and produces results with high internal validity as there is:

- Clear understanding of what has been done
- A process of evaluating conclusions in relation to methods employed
- the possibility to validate results by replication

The weakness of this method lies in the fact that it deliberately divorces a phenomenon from its context, so that attention can be focused on only a few variables. It was vital that the phenomenon under study be investigated in its natural setting and the experimental approach fell short on this aspect. This weakness paved the way for the case study approach.

4.3.2 Case study

A case study is used to explore a single phenomenon in a natural setting using a variety of methods to obtain in-depth knowledge (Collis and Hussey, 2009). In case study research, the boundaries between phenomenon and context are initially not clearly evident and no experimental control or manipulation is required. Yin (2009) notes that case study research attempts not only to make discoveries about phenomena but also about context and the impact of context on the object of the research. He adds that case studies allow investigators to retain the holistic and meaningful characteristics of real life events. He posits that the essence of a case study lies in the fact that "*it tries to illuminate a decision or set of decisions: why they were taken, how they were implemented and with what result*."

Given the nature of the problem under study and the need to understand the dynamics present within a single setting, the case study was chosen as the method of enquiry for this research. Yin (1984, 1994, 2004), Stake (1995) and Merriam (1988) agree that case study research can include both single and multiple case studies. This study uses a single case study.

4.3.3 Relevance of the case study research method to this study

Air transport liberalisation is celebrated as a panacea to air transport network deficiencies. Published literature on air transport liberalisation is replete with success stories in which the strategy has facilitated the development of new routes and improved network connectivity. Deregulation is credited for the upsurge in a new breed of carriers that have made air travel accessible to those with income levels below those previously associated with this means of transport. These success stories of liberalisation-induced network efficiency seem to have side-stepped SADC. The case study method of enquiry allows a problem to be understood within its context and so offered the best method to investigate the difficulties that SADC had to tackle, and to suggest solutions appropriate to the specific circumstances of the region.

As highlighted in the literature review, this study was conducted in a region where few research projects have been undertaken. The paucity of a strong theoretical base on air transport liberalisation strategy in developing regions where the majority of inhabitants live below the poverty datum threshold, created fertile ground for the use of SADC's phenomena as a case study in a bid to contribute significantly to theory.

Reconciling the conflicting objectives of pursuit of profit maximisation (one of the principal drivers of liberalisation) with social welfare obligations inherent in provision of air transport services in a region well-known for high poverty levels was pivotal to finding answers to the fragmentation of services in SADC. The case study approach, as it permits the use of multiple sources of evidence in the same research project, was the most appropriate method for such in-depth examination.

One criticism about the case study approach is on generalization of results. The limitation of this study stems from the fact that results obtained cannot be generalised to other developing regions. However Yin (2009) advises that case studies are generalisable to theoretical propositions and not to populations or universe. The goal for the SADC case study was to expand and generalise

theories on air transport liberalisation in developing countries. Using the case study approach in this research helped in identifying the challenges developing countries face with air transport liberalisation. One core contribution the study makes is the demonstration that air transport liberalisation in developing countries does not necessarily deliver the same significant benefits that developed countries obtain from its implementation.

4.4 Research design

Yin (2009) suggests five components that are critical in case study research design. He points out that a research design should indicate what data are to be collected as indicated by a study's questions. The design should also tell what is to be done after the data has been collected as indicated by the logic linking the data to the propositions and the criteria for interpreting the findings. This case study relied on multiple sources of evidence, with data needing to converge in a triangulating fashion. Figure 4-1 presents the research design of this study which was chosen because of its ability to give the best insight into the research problem.

Research Question	Data collected	Data collection tool	Purpose for data collected
How good was the implementation of the liberalisation strategy ?	Quantitative and qualitative data	Benchmarking exercise	Identification of deficiencies in strategy implementation Identification of better practices
How sufficient is demand to justify direct flights on those city-pairs that do not have such connections?	Quantitative data	Econometric modelling Statistical analysis	Identification of potential routes that can help reduce fragmentation of the network
Why has SADC failed to achieve positive results between the period July 1998 and April 2011?	Qualitative data	Documentary analysis Literature review Interviews	Analysis of the problems that are unique to SADC
How would a demand driven network become a reality in SADC?	Quantitative and qualitative data	Findings from benchmarking, econometric modelling and problem analysis	Proposals and recommendations on a network that best meets the needs of SADC.

Figure 4-1 Research design for intra-SADC network study

4.5 Data collection and analysis

The case study method relies on both primary and secondary sources of data. Primary data, which is original researcher generated data, was gathered through benchmarking, econometric modelling and interviews. Secondary data is the existing published and unpublished literature on the subject of study. The physical and online library resources in the form of books, journals and academic studies on YD implementation, offered the research desktop access to extensive literature. Yin (2009) observes that case studies are concerned with rigorous and fair presentation of empirical data. In this study, data

collection and analysis was organised in a way that supported the achievement of each of the objectives the study set out to accomplish.

4.5.1 Benchmarking data and analysis

Following from the graph theoretical approach that the study adopted as the conceptual framework, the starting point for collection of data for benchmarking was the construction of the real-world airline networks for the three regions of SADC, ASEAN and MERCOSUR. These networks were derived from direct (non-stop) scheduled flights between the airports that the study established as the significant nodes in each member state of a region. The real-world networks were then abstracted as graphs. The graph theoretic measures the study elected to adopt from the literature review chapter were used as the common metrics on which SADC's efforts at liberalisation were benchmarked. The objective of benchmarking is satisfied by comparing, in graph theoretic language, network efficiency gains achieved by the anomalar and the two exemplar networks, between onset of reforms and April 2011. The distinction between effective and ineffective strategy execution centred on the extent of the transformative effect of liberalisation on each of the three regional networks as judged by the four graph theoretic measures of;

- Connectivity
- Accessibility
- Circuity
- Market concentration

The analysis was carried out quantitatively as follows:

- Connectivity was assessed on the basis of improvements towards maximally connected graph and route length per airport
- Accessibility was measured by reduction in number of steps or distances
- Circuity was assessed by the reduction in degree of circuity
- Market concentration was analysed on the basis of a guideline that classified concentration ratios into three categories of low, moderate and

high. The modalities of how the scales were developed are expounded in chapter 5.

4.5.1.1 Sources of data for benchmarking

Data for the construction of networks was gathered from the OAG. The OAG is a statistical database that contains information on scheduled flights of all airlines. It provides, inter alia, information on the number of flights scheduled by operating carriers between airport pairs each day and the number of seats these flights provide. This provides adequate measures for flight frequency between city pairs. Grubesic et al (2008) argue that airline schedule data remains the most complete source of network connectivity information available for analysis. The data also distinguishes service provision between the designated airline (operator) and the carrier actually providing the service (partner). Another important feature is that it classifies the nature of flight operations in accordance with the commercial agreements on the routes. The flights are categorised as regular, code-share or leased space.

This study only considered those flights offered by carriers owned within each region. Where the OAG database yielded intra-regional routes with flight connections offered by carriers based outside a region, the existence of commercial agreements (e.g. code-shares) were used to determine the inclusion of such services in the analysis. For SADC, non-SADC African carriers using fifth freedom traffic rights to operate in the region were included in the analysis. This is because the provisions of the YD allow these airlines to sell tickets for the intra-SADC sectors they operate. This affected routes served by Ethiopian Airlines (ET) and Kenyan Airways (KQ). For non-African airlines such as Air Portugal (TP), their regular flight operations were not counted as intra-SADC connections as the YD applies to African carriers only and non-African carriers are not able to market intra-SADC flights.

As a market concentration ratio, the HHI is based on actual passenger numbers carried by each airline on a route. This data is not readily available. Data sets on flight operations and seat capacity that are available from the OAG database

could be used as surrogate indicators of market share. Flight frequencies instead of seat capacity formed the basis on which the HHI was calculated. This decision stemmed from the likely distortions that the diversity of aircraft sizes used on the routes would cause in such calculations

4.5.1.2 Assumptions on regional community membership

To facilitate comparison across the study, this research assumed all current member states to have had full membership for the whole period under review (July 1998 to April 2011). Madagascar, as a result of this rule, though not a SADC member in July 1998 was counted as a member. The rule was also applied to associate members and pending applications for membership in the MERCOSUR. Bolivia, Chile, Colombia, Ecuador, Peru and Venezuela were therefore treated as members in the analysis of MERCOSUR. The motivation for applying this rule was the need to eliminate complications in calculating and assessing network changes. As the study uses a graph as a unit of analysis, changing number of nodes would create complications in interpretation of results over the period under review.

4.5.1.3 Better practice data in exemplary regions and analysis

The identification and documentation of better practice in exemplary regions was done qualitatively by reviewing literature on liberalisation in ASEAN and MERCOSUR. The study made use of secondary sources of data. The main sources of evidence were;

- Peer reviewed published academic work on the two regions
- IATA commissioned studies on liberalisation
- ICAO-based analysis
- Technical reports from the World Bank
- Online secretariat reports from the ASEAN and MERCOSUR regions.

The study also made use of audited financial statements of those airlines that are listed on the stock exchange such as Singapore Airlines, GOL and LAN

Chile. The management reports contained in these audited statements were considered a rich source of qualitative data as they provided an insight into the gains of liberalisation from the perspective of key participants on the two regional air transport markets.

The analysis of what constitutes better practice was carried out qualitatively and it was structured around four thematic issues that are widely acknowledged as facilitators of improvements in air service provision. These are the;

- Nature of traffic rights that exist within the region particularly the granting of fifth freedom traffic rights
- Extent of private sector participation in the regional air transport market
- Existence of operational competition regulations
- Strategic health of the airlines that serve the regional market

4.5.2 Potential air travel demand data and analysis

Amongst the various methods for estimating air travel demand, this research opted for a structural or econometric model to address this objective. The econometric model developed for the SADC was problem specific. Its focus was to analyse demand on those city-pairs that did not have direct air services connections. The model attempts to replicate air travel demand and the determinants of the travel patterns on the intra-SADC routes by using mathematical equations based on theoretical statements about this transport system. The technique involves collecting data (observed or experimental data) and then expressing demand as a function of some selected explanatory variables.

The dependant variable for this research was the volume, per week, of air passenger traffic between city-pairs connecting the busiest airports in each of the SADC's member states. Demand for cargo traffic in terms of tonnes per week was considered to be beyond the scope of the study. The volume of the passenger traffic was postulated to be a function of a number of quantitative and qualitative factors that are known (theoretically and empirically) to influence

air travel demand; i.e. population, income, tourism, distance, shared language and political stability. The econometric model that was developed for SADC followed the typical seven step process advocated by ICAO (2006). The detailed explanation on the steps followed and the nature of the explanatory variables that were selected is provided in the results and analysis chapter.

The data collected for this model had to satisfy three requirements. For the purposes of this research the data had to be available for all the airports identified as significant nodes in each of SADC's member states and it had to be readily attainable. The data also needed to be consistent.

Out of the maximum possible 105 direct flight connections between the major economic cities of the SADC region, data obtained from OAG shows that only 41 city-pairs have had such connections at any time during the period under review (see Appendix B). Of these 41, only twenty-nine have had consistent services between them. For 11 routes, the provision of direct air service connections has been erratic. As a result the econometric model was calibrated to fit cross-sectional data on 32 intra-SADC city-pairs that had air service connections in 2009. The most recent data (for both the dependent and independent variables) that was at the disposal of the study was for the year 2010. The justification for opting for 2009 instead of 2010 was to circumvent the distortions arising from traffic generated by the 2010 World Cup, held in Southern Africa. This was a once-off event that inflated passenger figures at many of the airports in SADC.

Calibration entails the specification of a model structure, the statistical estimation of its parameters and the evaluation of the parameter estimates. With the aid of multiple regression analysis and statistical software packages namely MINITAB and Microsoft Excel, the econometric model was calibrated to lead to the most accurate prediction of the expected air passenger traffic volume. The model was also validated to check whether it could reproduce a known state of the system with sufficient accuracy. This entailed incorporating data independent from that used in the calibration process. The calibrated model was then applied to generate levels of air passenger demand that might

be expected between city-pairs that did not have direct air services connections in 2009.

Although the use of cross sectional data instead of time-series and/or panel data was occasioned by the unavailability of the two types of data sets, this method is not flawless. The weakness of developing an econometric model based on cross-sectional data for a single year lies in assuming that the model yields long-run elasticities (Kaemmerle, 1991) and that all city pairs share the same demand characteristics. However for the SADC study the use of cross-sectional data remains a valid research route as the focus is on a specific geographic region, and countries forming a common economic and trading environment. The assumption that all city pairs have the same demand function is likely to hold true for all the different routes within SADC.

4.5.2.1 Sources of data for econometric model development

In order to satisfy the requirements of availability, attainability and consistency, the sources for primary data were limited to a few databases. The major sources for primary data on the dependant variable (volume of passenger traffic) that this study considered were the following:-

- OAG
- MIDT,
- SADC member states[5],
- Airlines serving the intra-SADC network
- Airlines Association of Southern Africa (AASA)
- African Airlines Association(AFRAA)

This study relied on MIDT and OAG as the sources for developing primary data for volume of passengers between city-pairs. The technicalities on how the two databases were considered as satisfying the requirements of the study are covered in Chapter five.

[5] Central statistical offices, ministries of transport, aviation authorities, airport companies, tourism authorities

The major sources for explanatory variables for the econometric model varied and were dictated by the nature of factors that were selected for inclusion in the model. They however had to meet the same criteria that were applied for the dependant variable. These sources are also discussed in detail in chapter five.

The use of the case study approach however restricted the sourcing of data for model estimation/calibration to SADC. A different methodology could have permitted the use of ASEAN data to mirror and characterise air travel demand patterns in SADC. This was the same approach adopted by Alder and Hashai (2005) when they tested the demand model developed for the Middle East region against data sourced from Europe. This approach was not followed because this study considered it inappropriate to use data drawn from one case study to draw conclusions on another case study.

4.5.3 Data on reasons for liberalisation strategy failure

This study was carried out over the period November 2008 to April 2011, after a decade of air transport restructuring in SADC. The primary objective was to assess the progress of the implementation of the process of change, and its impact on air transport network efficiency. The reasons behind any failures to deliver the results expected from air transport liberalisation in SADC would be identified.

Literature on effective and efficient business strategy execution suggests three key factors as missing links when strategy implementation fails to work as designed. These are direction, structure and people (Getz and Lee, 2011). They argue that efficient execution must be underpinned by;

- Direction - a roadmap for where to go
- Structure- a holistic description for how work will be conducted
- People - resources for doing the work

This study used these three pillars as the basis on which qualitative evidence was gathered and analysed. The study used both primary and secondary

sources for data gathering and analysis of these three factors. A total of twenty individuals were interviewed for the purpose of gathering primary data.

Nine in-depth interviews were conducted with airline officials. Eight of these were held with senior managers in route network development within SADC airlines, namely Angola (TAAG Angolan Airlines), Mauritius (Air Mauritius), Mozambique (LAM Mozambique), Namibia (Air Namibia), South Africa (South African Airways), Zambia (Zambezi Airlines) and Zimbabwe (Air Zimbabwe). The focus was to establish airline officials' perception on how direction, structure and resources have influenced the implementation of reforms. One of the prominent airline official interviewed was Girma Wake, the then Chief Executive Officer of Ethiopian Airlines. The objective was to get an insight from an airline based outside SADC regarding the three features of direction, structure and resources. Apart from being the best performing airline in Africa, Ethiopian Airlines is one of the airlines that has defied the myths of inefficient state ownership and is a major player in SADC where it also exercises some fifth freedom traffic rights in accordance with the provisions of the YD.

The research also used semi-structured interviews to collect data from eleven senior policy advisors within civil aviation in SADC. For instance, face-to-face interviews were held with the Programme Officer for air transport within the SADC Secretariat, Jonathan Majakwara. These interviews sought the perspectives of those in advisory roles regarding the nature of an implementation roadmap. In addition, ten interviews were carried out with senior officials responsible for YD implementation within the ministries of transport and civil aviation authorities in Namibia, Swaziland, Zambia and Zimbabwe. These interviews (see the interview guide in Appendix H) focussed on establishing the practitioners' perspective on the implementation programme.

The research also made use of information gathered during discussions in conferences and seminars. Two conferences that stand out are;

a) AFRAA's 42nd Annual General Assembly held in Addis Ababa from 21st to 23rd November 2010. The conference whose theme centred on

"adapting to survive and prosper " came up with various resolutions chief among them, the need for African governments to fully liberalise the air transport market. (AFRAA, 2011)

b) An Embraer sponsored airline business seminar held in Nairobi Kenya in July 2011. The conference centred airline connectivity in Africa, a theme that had direct relevance to the subject of this study. In addition the host airline was Kenyan Airways, one of the success stories of privatisation of airlines in Africa (Morrell, 2007). Discussions that centred on their experiences and perceptions on the YD enriched this research with insights on the importance of resources.

Furthermore this research relied on the following secondary sources;

a) Previous studies on the SADC network, e.g. (Schlumberger, 2010)
b) SADC secretariat reports and minutes of conferences and meetings,(AU, 2005; SADC, 2010)
c) World Bank research on SADC infrastructure and implementation of the YD
d) SADC airlines' audited financial statements

4.5.4 Design of an ideal demand driven network

This objective was satisfied by converting the estimates of potential demand, obtained from the econometric model to the number of weekly flights required to satisfy that demand. Assuming load factors at sixty per cent, and the capacity of aircraft employed limited to that of regional aircraft; the threshold for eligibility for direct air service connections was two weekly flights. Routes with adequate demand to justify such connections were then used to design a demand driven network. The quantitative graph theoretic measures of alpha ($\boldsymbol{\alpha}$), beta ($\boldsymbol{\beta}$), gamma ($\boldsymbol{\gamma}$), theta ($\boldsymbol{\theta}$), Shimbel Index, L-Matrix and degree of circuity are calculated to show the extent to which the proposed routes would lessen fragmentation of air service connections in SADC.

4.5.5 Recommendations on measures to improve intra-SADC air service connections

In order to achieve this objective, the study made use of the following evidence;

- Gaps identified in air service levels and better practice documented from the benchmarking exercise
- Ideal passenger demand driven network arising from demand estimation exercise
- Evidence on the unique air transport needs of SADC in relation to direction, structure and resources

4.5.6 Triangulation of data from the various sources

This case study relied on multiple sources of evidence, with the data needing to converge in a triangulating fashion. Figure 4-2 summarises how this study incorporated triangulation in gathering data and finding solutions to the fragmentation of the intra-SADC air transport network.

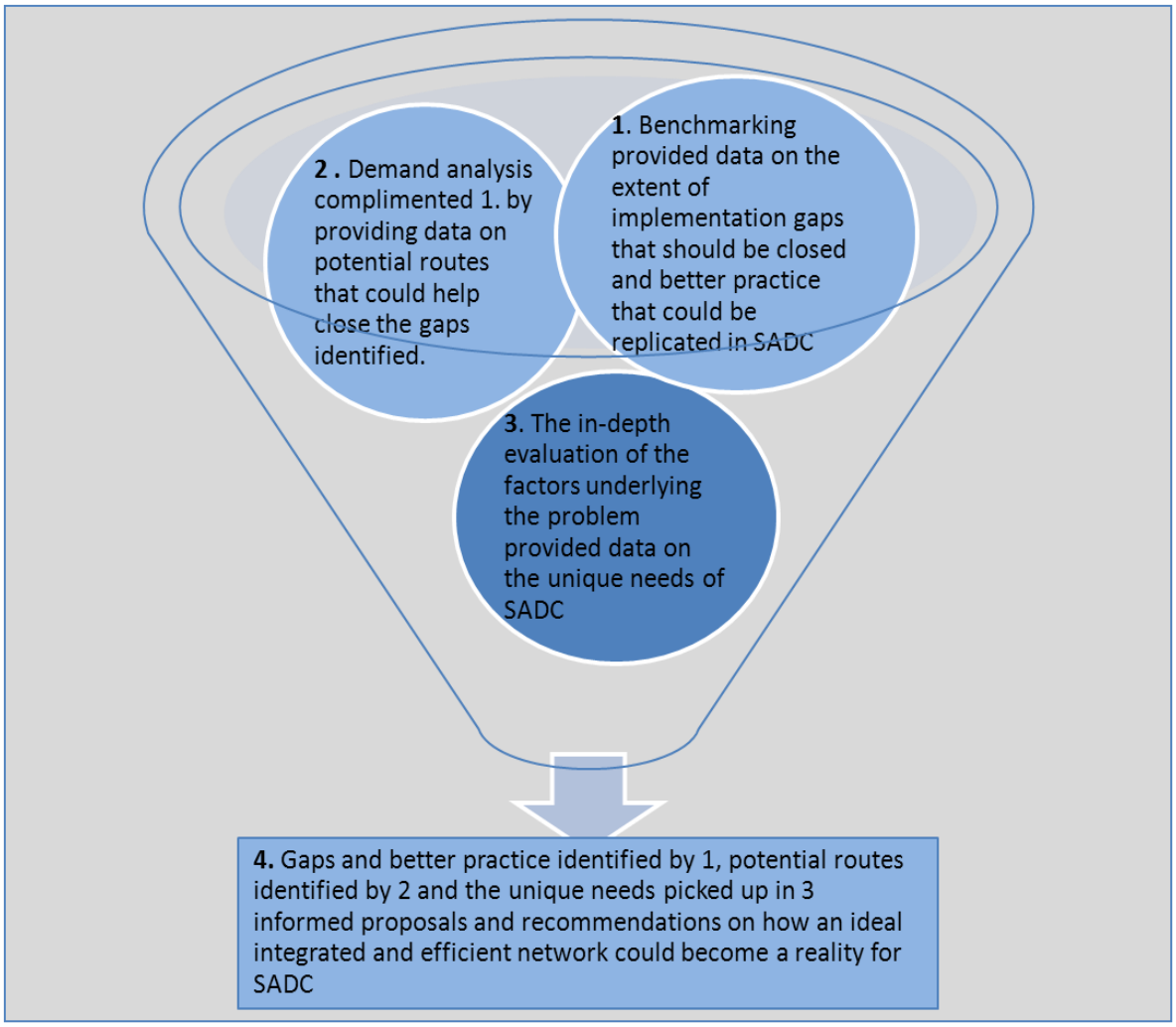


Figure 4-2 Data triangulation for SADC case study

4.6 Delimitations

The focus of this study is the spatial structure of the intra-SADC air transport network. Even though airport infrastructure and aircraft technology are key to the liberalisation strategy of the regional air transport system, this research does not purport or attempt to investigate them. The study assumes that airport infrastructure is a resource that can be provided. The World Bank (2010) suggests that adequate airport infrastructure exists in SADC. They argue that what is required is maintenance and upgrading of the existing infrastructure

Although aircraft size that is matched to demand and regional aircraft operating economics are an important factor in determining network design, this aspect was considered to be beyond the scope of this research.

Recommendations on an ideal network were based on the assumption that new routes on the intra-SADC network are not constrained by airport infrastructure or aircraft technology and thus, with government approval, routes can be added or deleted.

4.7 Limitations

This study encountered three major constraints; unavailability of consistent data, method of enquiry and resources. To overcome these constraints, the study adopted methods that still ensured research rigour and the attainment of research objectives. The absence of any meaningful data sets necessitated the use of a multi-source approach to accumulate new and essential information.

Results obtained from cases studies are however not generalisable to other developing regions. The objective of this study was to seek answers to the problems besetting SADC in the context of liberalisation theory, and not to generalise to developing regions.

Resources for the study were limited and a result the use of market research, a technique that could have performed better in estimating demand was considered a more costly option. An equally strong method, an econometric model of the gravity type was used instead. Although this technique is a broad-brush approach, empirically it has produced good results on routes with no historical data; the case obtaining in SADC.

4.8 Conclusion

Two concerns arise in any research project. First and foremost it must answer the questions raised by the study. Secondly the project must be carried out in a sufficiently rigorous manner. To ensure the most efficient and effective way of collecting and analysing data for the problem under investigation and to

enhance academic rigour; this study is located in both the positivist and interpretivism philosophies. The uniqueness of SADC network's fragmentation in the midst of a transformation process presented this research with an opportunity for a rich analysis of challenges to air transport liberalisation in developing regions. There was therefore need for the study to retain the holistic and meaningful characteristics of this phenomenon. This in turn dictated the use of the case study approach as the most relevant method of enquiry for the problem. Apart from the ability to produce both quantitative and qualitative data in the same study, the case study approach allows a problem to be understood within its context.

The combination of both quantitative and qualitative techniques in the same study strengthens the realisation of the research objectives and unravelling the factors underlying the difficulties in strategy implementation in SADC.

5 Chapter Five: Benchmarking

5.1 Introduction

This chapter explores and analyses the data obtained from the benchmarking exercise carried out by this study.

There is empirical evidence that air transport liberalisation as a strategy for network efficiency has had progressive transformative effect on the regional networks of ASEAN and MERCOSUR. The purpose of benchmarking SADC's post liberalisation network to these two developing regions was to address the question of whether the necessary and sufficient conditions for effective strategy execution were satisfied. Whilst it might be difficult to establish the actual competencies inherent in the exemplar regions, the observable transformational change achieved by their networks can be used as a proxy for superior performance. The motivation for using these two is fourfold;

a) ASEAN and MERCUSOR are airline networks operating in a similar socio-political-economic environment as SADC.
b) The two regional networks have performed significantly better in terms of network development under a regime of limited air transport deregulation, than has SADC.
c) Best practice from analysis of ASEAN and MERCOSUR strategies and implementation can be identified.
d) This best practice can be used to suggest improvements to SADC strategies and implementation

Moriarty (2011) advises that understanding the state of affairs of the bench marker before undertaking any benchmarking exercise is vital if the exercise is to deliver value. He contends that "anomalous state of affairs must first be understood in terms of their properties, rules and statistical variations before exemplars are engaged in the benchmarking process."

Air transport growth is driven by the activities that it supports (i.e. business and vacation trips) and also derived from other selected economic or social factors

(O'Connor, 1995). Published air transport literature categorise the factors that underpin air transport development into two groups of geo-economic and service-related factors (Grosche et al, 2007; Rengaraju, Thamizh and Arasan, 1992; Kanafani, 1983). Arguing that geo-economic factors are outside the control of airlines, Jorge-Calderón (1997) describes geo-economic factors as the economic activities and geographical characteristics of the air transport markets that airlines serve. The activities that literature cites most are income, population, income distribution, structure of the production sector, as well as economic, political and cultural relationships between countries (Russon and Riley, 1993; Grosche et al, 2007; Doganis, 2006). The geographical factor presumed to have the greatest influence is the distance between cities. Jorge-Calderón (1997) argues that distance has two conflicting effects. This is because increasing distance leads to lower social and commercial interactions but longer distances increase the competitiveness of air transport compared to other transportation modes. The existence of substitutes to air transport is also known to have an impact on the growth of air transport. Jorge-Calderón (1997) argues that generally, the demand for air travel decreases with increasing fares and on short-haul routes, airlines face competition of other modes that gain a relative advantage with increasing airfares.

The implementation of civil aviation reforms as is the case with any structural changes within an economy rely on the same factors that drive the growth of air transport market. Bergeijk (1996) argues that a reform programme will only have a chance to succeed when it is both economically and politically sound. He cites various factors that he believes are important determinants for any strategy that aims at structural change in any economy. These are the;

a) Level of education
b) Strength of the private sector
c) Social security arrangements
d) Level and distribution of income
e) Functioning and depth of capital markets
f) Administrative skills of the government sector

g) Political set-up

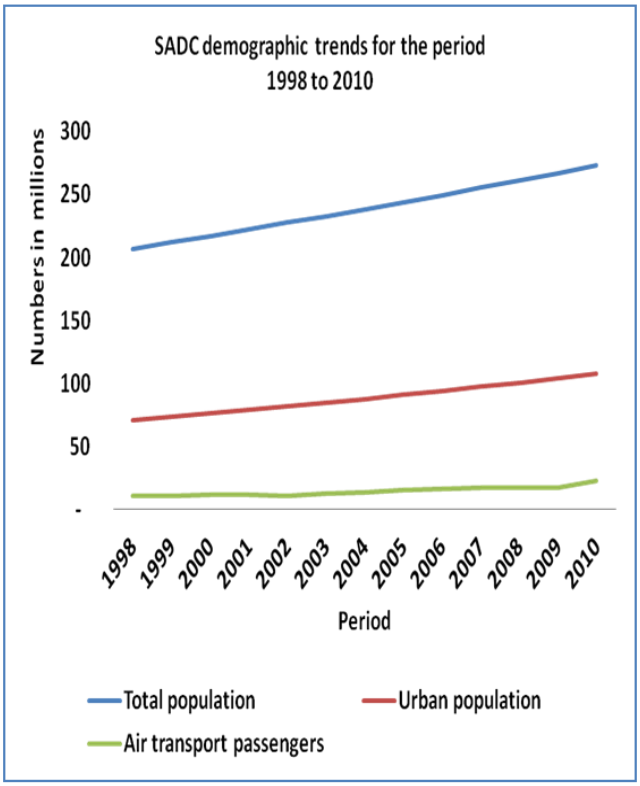
This chapter will explore the characteristics of SADC by examining selected demographic and socio-economic characteristics that have a role in shaping the intra-SADC air transport network and are considered important to reforms aimed at structural change. The chapter will also explore SADC's inter-country trade and tourism patterns. An appraisal of the threat posed by substitute modes of transport precedes the benchmarking exercise and the analysis of these results. The identification of better practice concludes the chapter.

5.1.1 Selected demographic and social indicators

The population of a region symbolises the potential market that airlines can tap into to develop their networks. On the basis of the latest statistics available from the World Bank development indicators, SADC has a large population that has grown from 206 million at the beginning of reforms to 273 million in the year 2010. Indicators for air transport passengers carried exhibit a marginal increase. The statistics on air transport passenger numbers that were sourced from ICAO include all the arrivals and departures for scheduled and unscheduled international and national air travel. Literature on air transport suggests that the potential users of air transport are those inhabitants that reside in urban areas (Hilling, 1996). Figure 5-1 summarises the findings of the assessment of SADC population, urbanisation and air transport passenger trends. The figure indicates a linear relationship amongst population growth, urbanisation and air transport passengers carried. The World Bank (2011) forecasts that population will maintain the growth trend at a rate higher than 3 per cent.

A quantitative assessment of the air transport intensity was obtained by dividing the number of air transport passengers by the number of urban inhabitants. The reason for using urban population was theoretical as it is assumed that those in urban areas are likely to travel by air as the airports that are the focus of this study are in urban centres. This does not however suggest exclusion of rural people from using air transport.

SADC Population Statistics			Air transport Index	
Country	Total inhabitants "millions"	In urban areas 'millions'	Passengers carried "millions"	Passengers per urban inhabitant
Angola	19.08	11.16	1.283	0.1
Botswana	2.01	1.23	0.290	0.2
DRC	65.97	-	n/a	n/a
Lesotho	2.17	-	n/a	n/a
Madagascar	20.71	6.26	0.417	0.1
Malawi	14.90	2.95	0.172	0.1
Mauritius	1.28	0.55	1.268	2.3
Mozambique	23.39	8.98	0.553	0.1
Namibia	2.28	0.87	0.488	0.6
Seychelles	0.09	0.05	0.449	9.4
South Africa	49.99	30.84	16.779	0.5
Swaziland	1.06	-	n/a	n/a
Tanzania	44.84	11.84	0.749	0.1
Zambia	12.93	-	n/a	n/a
Zimbabwe	12.57	4.81	0.302	0.1
Total	273.27	79.54	22.75	0.29



* n/a data not available

Source: Analysis based on data gathered from World Bank Development Indicators 2011

Figure 5-1 SADC demographic indicators and trends

When compared to EU (see Appendix C) where the air transport passenger per inhabitant ranges between 0.3 in Slovakia to 8.7 in Cyprus for the year 2010, SADC countries' indicators exhibit underdevelopment of the air transport market. The regional average of 0.29 against 1.2 registered by the EU illustrates the extent by which SADC lags behind developed countries.

One social indicator that the United Nations Educational, Scientific and Cultural Organisation (UNESCO, 2011) considers a cornerstone for social and human development and economic growth in nations is literacy and numeracy. Considered key to communication and learning of all kinds, UNESCO (2008)

considers literacy and numeracy a fundamental condition of access to today's knowledge societies. UNESCO argues that communication through reading and writing is part of every society and organisations depend on literacy for making decisions, communicating knowledge, making plans and documenting action. In addition they posit individuals rely on literacy and numeracy for daily transaction, learning, leisure and contact across time and distance. On the basis of the most up-to-date World Bank statistics that gauge the level of achievement of literacy, comparative assessment of literacy levels in SADC countries was carried out. A snapshot of the findings is presented in Table 5-1.

Table 5-1 Comparative analysis of SADC's social indicators with exemplar regions

SADC	Adult Literacy %	Political Stability Index (-2.5 to +2.5)
Angola	70	-0.22
Botswana	84	0.91
DRC	67	-2.2
Lesotho	90	0.48
Madagascar	64*	-1.13
Malawi	74	0.08
Mauritius	88	0.53
Mozambique	55	0.32
Namibia	89	0.75
Seychelles	92*	0.81
South Africa	89**	-0.03
Swaziland	87	-0.06
Tanzania	73	-0.01
Zambia	71	0.48
Zimbabwe	92	-1.21

* Data relates to 2008 **Data relates to 2007
n/a: Data not available

ASEAN	Adult Literacy %	Political Stability Index (-2.5 to +2.5)
Brunei	95	1.24
Cambodia	78*	-0.62
Indonesia	92	-0.89
Laos	n/a	-0.23
Malaysia	92	0.14
Myanmar	92	-1.29
Phillipines	95*	-1.56
Singapore	95	1.12
Thailand	n/a	-1.22
Vietnam	93	0.13

MERCOSUR	Adult Literacy %	Political Stability Index (-2.5 to +2.5)
Argentina	98	-0.01
Bolivia	91*	-0.4
Brazil	90*	0.05
Chile	99*	0.61
Colombia	93	-1.49
Ecuador	84	-0.63
Paraguay	95**	-0.88
Peru	90**	-0.87
Uruguay	98	0.89
Venezuela	95**	-1.37

Source: Compiled using World Bank Development and Governance Indicators databases

With the exception of Mozambique, Madagascar and DRC a number of the SADC states have made significant social and economic progress. In addition,

the literacy level of the states that have made good progress does not differ widely with those of the exemplar regions.

Political stability is a social indicator which according to the World Bank's World Governance Indicators (WGI, 2011) captures the likelihood that a government will be destabilized or overthrown by unconstitutional or violent means (including politically-motivated violence and terrorism). This indicator is known to affect the development of air transport (Vasigh et al, 2008). The indicator, that is assigned negative two and a half (-2.50) for highly unstable and positive two and a half (+2.50) for very stable governments, tells the story of a region prone to political instability. Comparisons across SADC countries indicate that many member states do not score well on this indicator. Indeed, the Democratic Republic of Congo, with an index -2.20, is ranked the least stable country in the world. Figure 5.2 indicates that political instability is not unique to SADC, the exemplar regions of ASEAN and MERCOSUR have unstable nations; Philippines, Myanmar and Thailand and Colombia and Venezuela, respectively.

5.1.2 Selected economic and development indicators

Literature on air transport lists economic activity and discretionary income among the main drivers for demand for air travel (Holloway, 2007). Hilling (1996) argues that there is a demonstrable positive relationship between the overall use of air transport and levels of income, urbanisation, industrialisation, education, and leisure time. In support of this assertion, ATAG (2005) argues that a strong correlation exists between GDP growth and air transport activity in an economy. This means that countries with higher GNI per capita (derived from dividing a country's GNI by its population) exhibit higher levels of air transport activity. This is because the relatively high GNI per capita available in these countries increases the propensity of people to spend on air travel. However, Hilling (1996) observes that, for developing countries, the relationship is multifaceted and not a one-way process. This section presents an analysis of some of the economic and development indicators that have a bearing on air travel. The indicators that relate to the year 2010 are presented in Table 5-2

Table 5-2 SADC economic indicators

Country	Gross Domestic Product (current US$)	GNI per capita Atlas method	Human Development Index	Tourism Potential Index	GDP Composition		
	billions	units			Agriculture	Industry	Services
Angola	84	3,940	0.5	0.02	9%	66%	25%
Botswana	15	6,790	0.6	0.80	2%	53%	46%
DRC	13	180	0.3	0.00	55%	11%	34%
Lesotho	2	1,040	0.5	0.15	15%	47%	38%
Madagascar	9	430	0.5	0.01	26%	16%	58%
Malawi	5	330	0.4	0.05	38%	18%	44%
Mauritius	8	7,750	0.7	0.68	5%	25%	71%
Mozambique	10	440	0.3	0.10	23%	31%	46%
Namibia	12	4,500	0.6	0.44	10%	36%	53%
Seychelles	1	9,760	0.8	1.80	2%	28%	70%
South Africa	364	6,090	0.6	0.20	3%	31%	66%
Swaziland	4	2,630	0.5	0.77	12%	45%	43%
Tanzania	23	530	0.5	0.02	27%	23%	50%
Zambia	16	1,070	0.4	0.05	17%	26%	57%
Zimbabwe	7	460	0.4	0.10	18%	23%	59%
Total	573						

Source: World Bank, United Nations Development Programme (UNDP), United Nations World Tourism Organisation (UNWTO) and CIA World Factbook

SADC member states, according to the latest World Bank development indicators, have registered high real GDP growth rates over the period 1998 to 2010. With a contribution of 63 per cent to the region's combined GDP, South Africa, dominates the regional economy.

However, an examination of the GDP composition of each member states shows that agriculture continues to be a major component of some member states' economies. Theory on travel and tourism suggests economies that are dependent on agriculture tend to generate lower tourism numbers (Boniface and Cooper, 2004).

In the absence of discretionary income survey data, the GNI per capita is used as a proxy for measuring the standards of living for a country. The World Bank uses this indicator for operational (lending) purposes to determine the stage of economic development and the income category of a country. The latest World Bank country classification based on 2011 GNI per capita and calculated using the Atlas method, puts five economies of SADC (Botswana, Mauritius, Namibia, Seychelles, and South Africa) in the upper middle income bracket. Angola, Lesotho, and Swaziland are in the lower middle income group. The other seven fall into the low income category. UNCTAD describes the low income economies as the least developed countries.

The Human Development Index (HDI) is described by the United Nations Development Program (UNDP, 2011) as a summary composite index that measures a country's average achievements in three basic aspects of human development; health, knowledge, and income. The index, whose origins is traced to the seminal work of Haq[6] and Sen is rooted in the argument that economic growth of a country does not translate into socio-economic progress of its inhabitants. The UNDP argues that HDI is a powerful alternative to national income for measuring relative socio-economic progress at national and sub-national levels. Assigned values between 0 and 1, a country's HDI places it in one of the four categories of Very High, High, Medium and Low Human Development. The latest UNDP HDI Report (2011) shows that Seychelles and Mauritius exhibit high human development levels. Botswana, Namibia, South Africa and Swaziland fall into the medium human development category. The other nine SADC member states (Angola, Madagascar, Tanzania, Lesotho, Zambia, Malawi, Zimbabwe, Mozambique and Democratic Republic of Congo) fall into the low human development category.

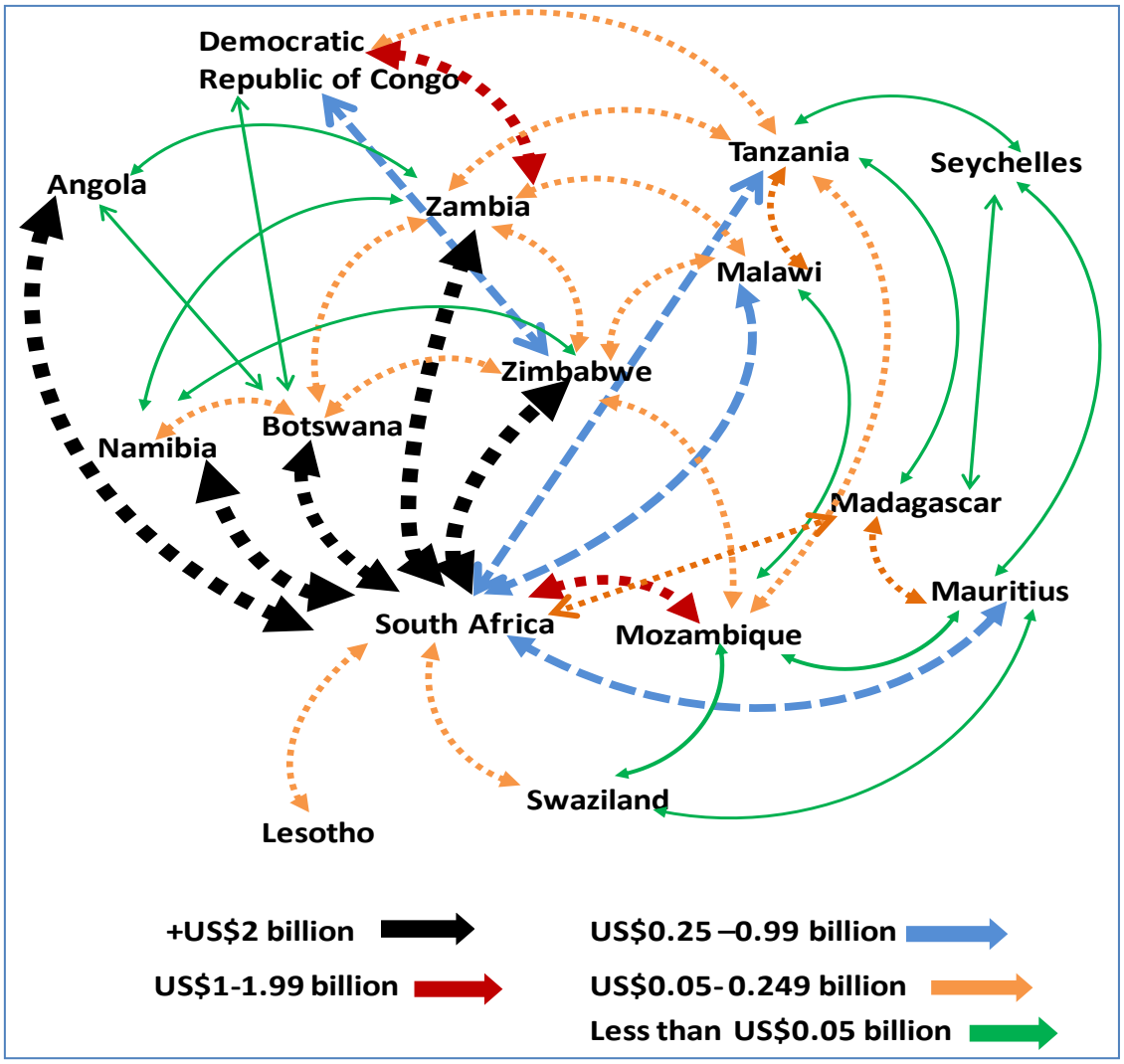
A quantitative assessment of the economic characteristics of ASEAN and MERCOSUR that is discussed in chapter 3 reveals that the two exemplar regions exhibit very similar characteristics as those of SADC where one or two countries dominate the regional economy.

[6] Human Development Report , 1990

The tourism potential index is used by the UNWTO to gauge the attractiveness of a country as a tourist destination. This indicator, derived from the ratio of non-resident visitors arriving in a country to that state's resident population (UNWTO, 2011) indicates that some SADC states rely substantially on tourism. Seychelles, Botswana, Swaziland and Mauritius attract substantially high tourism flows in comparison to their own populations.

5.1.3 Intra-SADC trade

While many member states still rely on Europe and America for their imports and exports, the region has witnessed meaningful growth in intra-SADC trade. Economically, the accession of South Africa to SADC in 1994 ushered in the prospects of a vibrant and strong regional economy. Simon and Johnston (1999) noted that South Africa's membership of SADC raised intra-SADC trade in 1994 to 22 per cent of members' total trade, a more than fourfold increase when compared to the 1991/2 level of 5 per cent. The trade flows as at December 2010 and presented in Figure 5-2 are concentrated around South Africa, the strongest economy of the region.



Source: IMF Direction of Trade Statistics 2010

Figure 5-2 SADC inter-country trade flows

Air transport literature suggests trade as one of the business activities that generate demand for air transport as a result of business and official travel (Oum et al, 2010).

5.1.4 SADC tourism patterns

The improved regional political stability and regional co-operation, increased trade activities; the growth in regional tourism, as well as the strengthening of both cultural and social ties among the SADC countries has largely dictated the pace at which intra-SADC traffic has grown. Most SADC countries share a common history of colonialism and the attainment of independence with the aid

of liberation movements that had shared aspirations and ideologies. The historical ties have been instrumental in improving regional cooperation and have influenced the patterns of regional trade and migration, which in turn shapes traffic patterns on the intra-SADC transportation networks.

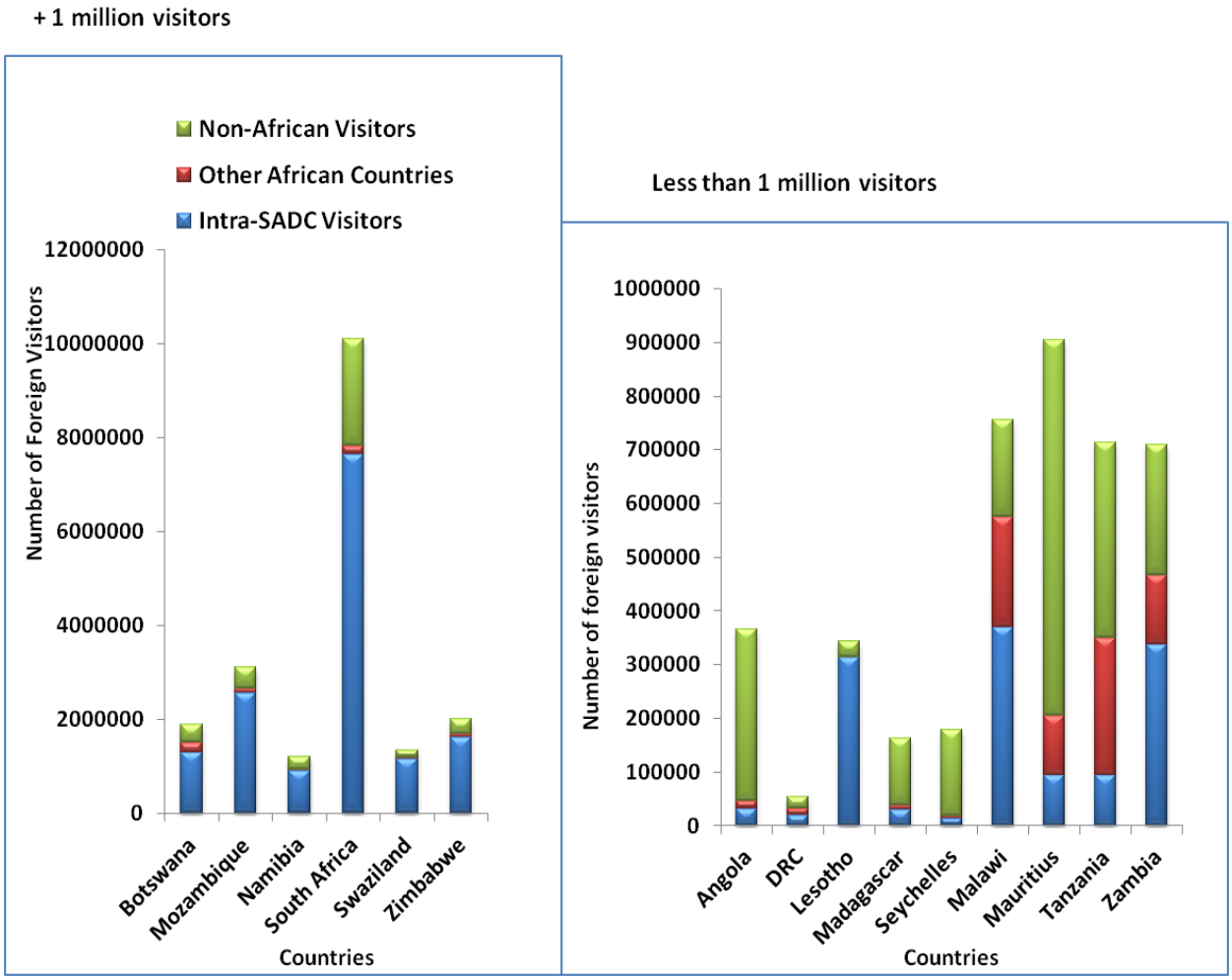
5.1.5 Tourism flows

The UNTWO (2011) defines a traveller as someone who moves between geographic locations for any purpose and any duration. Travellers are further classified into visitors and tourists. A visitor is defined as a traveller taking a trip to a main destination outside their usual environment for a period less than a year for leisure, business and other purposes other than to be employed by a resident entity in the country or place visited. A tourist on the other hand is defined as “any visitor travelling to a place other than his/ her usual environment for more than 1 night but less than 12 months and whose main purpose of visit is other than the exercise of an activity remunerated from within the place visited”. The overnight aspect is what separates visitors from tourist. A visitor who stays for at least one night is classified as a tourist. A traveller who visits a place and does not spend a night is described as a same-day visitor or excursionist.

The UNTWO further classifies tourism visits according to the direction of flows; inbound, domestic and outbound. Inbound tourism relates to the arrivals of non-resident visitors to a country. Domestic tourism entails trips by the residents of a country within that member state. The departures of a country’s residents to other countries constitute outbound tourism visits. This study was interested in intra-SADC travel statistics with potential to create demand for commercial civil aviation. The focus is therefore on inbound tourism (both overnight and same day visits). Outbound departures are ignored because they are captured as arrivals in the other member states visited.

The SADC tourism statistics capture the movement of nationals and foreign travellers in and out of a country for a specific period, normally a year. The data on tourism flows is obtained from immigration authorities at various entry points

(land, sea and air) in each of the member states. A snapshot of the region's tourism flows shows that SADC handled 23.7 million visitors in 2009. Forty-two per cent of these visitors were destined for the emerging market of South Africa. A scrutiny of the travel patterns within the SADC is illustrated by Figure 5.3. The results reflect that the majority of member states receive visitors from within the region.



Source: based on latest UNTWO(2011) statistics

Figure 5-3 Profile of SADC tourism flows

An analysis that was carried out to determine the pattern of inter-country tourism flows is demonstrated in Figure 5-4. The results indicate a concentration of tourism flows amongst and between neighbouring countries. Traffic between continental and island member states is thin. Intra-SADC traffic

also tends to concentrate around major economic and population centres in each of the member states notably capital cities. Except for South Africa and Tanzania where traffic is concentrated in Johannesburg and Dar es Salaam respectively, intra-SADC visits in other countries are destined for capital cities.

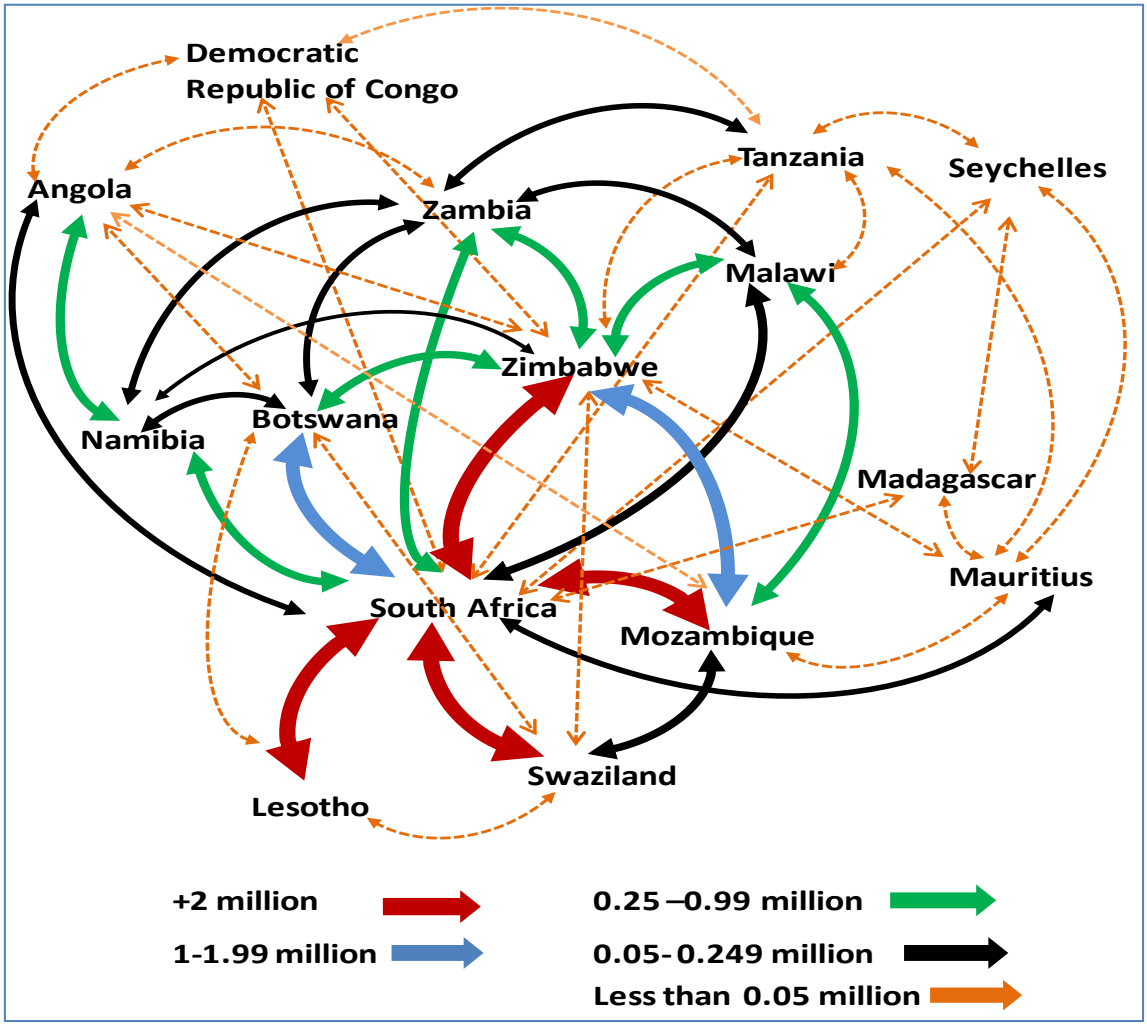
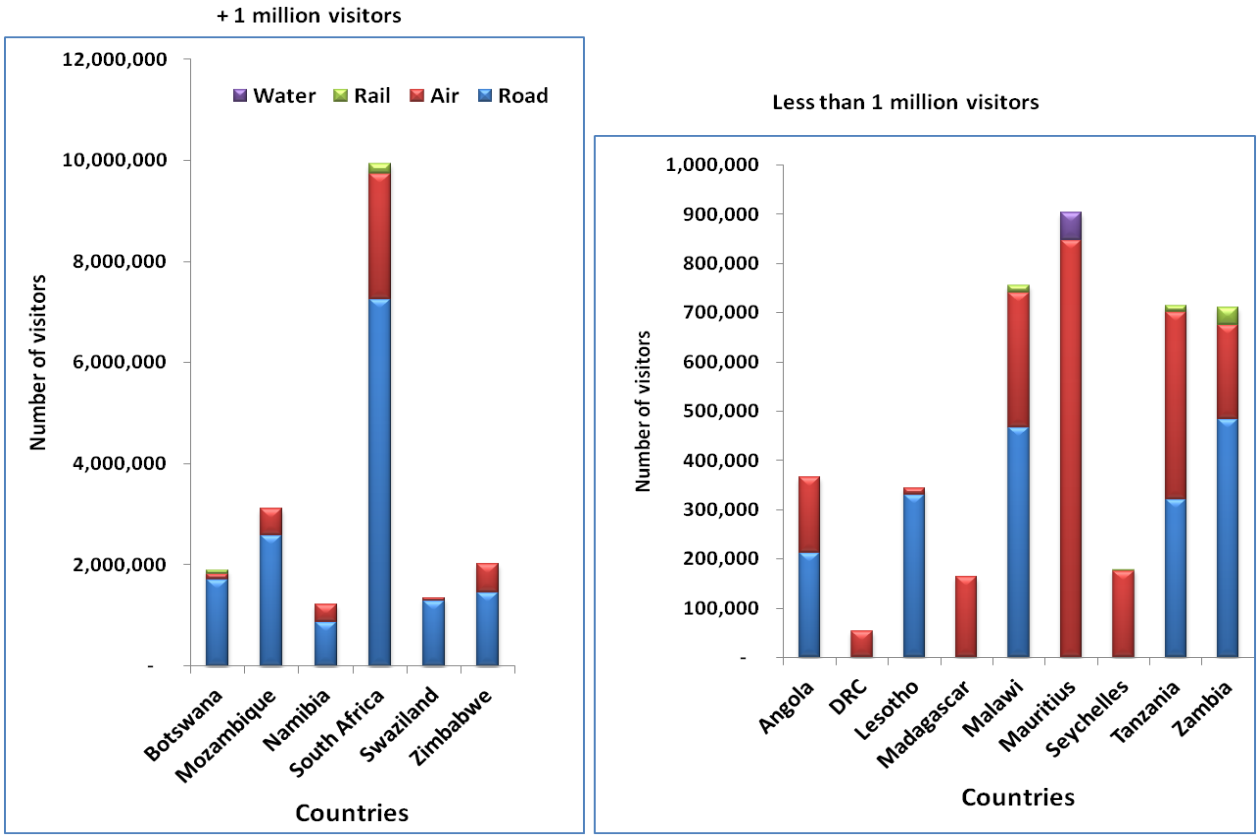


Figure 5-4 SADC inter-country tourism flows

The UNWTO classifies trips according to two main purposes, personal and business and professional. Personal trips involve holidays, leisure and recreation; visiting friend and relatives; education and training; health and medical care; religion/pilgrimages; shopping; transit and other. An analysis of the purpose of travel reflects that personal trips particularly holidays dominate the motivations for travel in intra-SADC flows.

5.1.6 Assessment of modes of transport in SADC

The modes of transport travel within SADC are principally road and air although some rail services exist. A quantitative assessment of the distribution of traffic by mode of transport used by tourism flows in SADC is presented in Figure 5-5. The results reflect that road transport accounts for the bulk of travel between mainland SADC countries.



Source: Based on latest UNTWO (2011) statistics

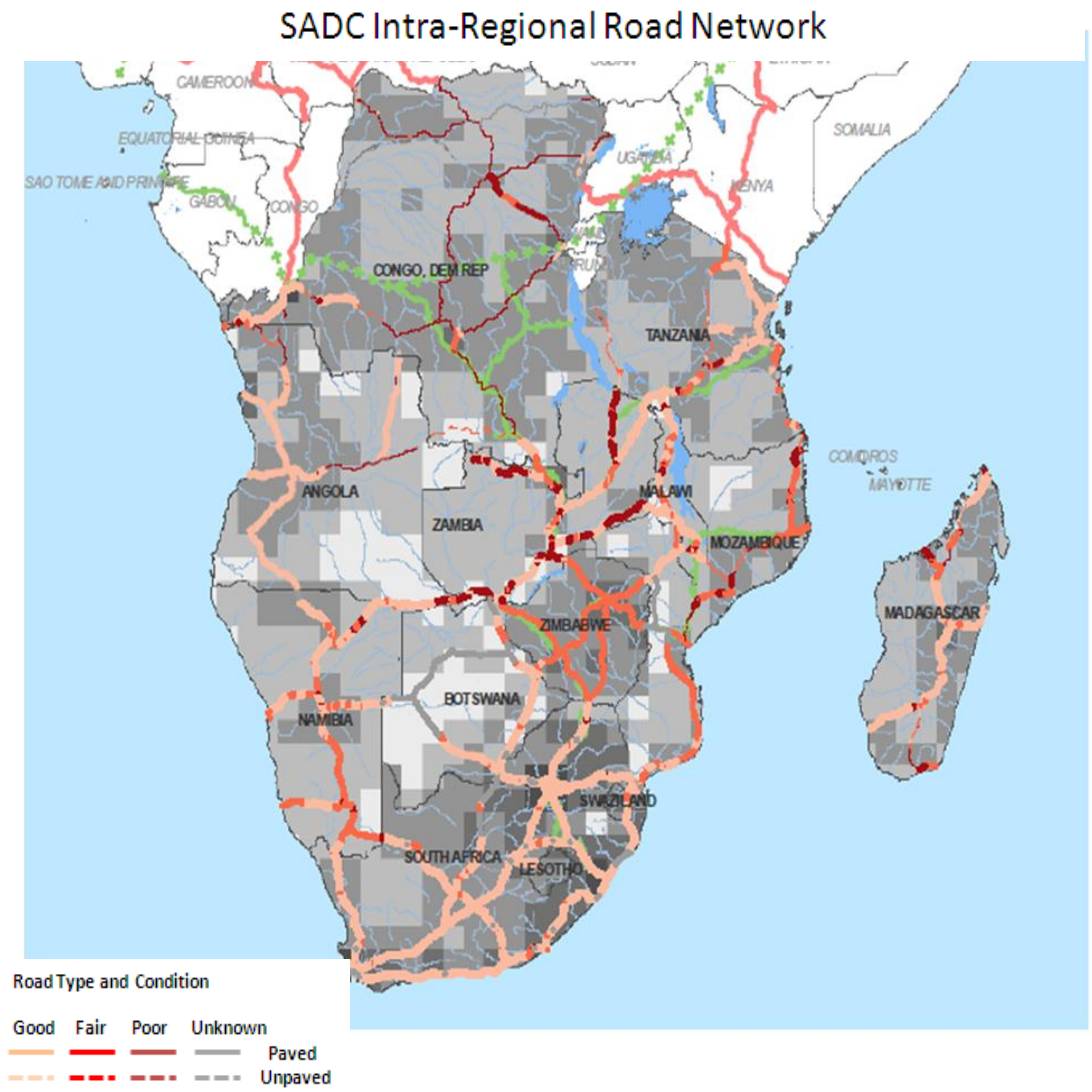
Figure 5-5 Transport modes used in SADC

Air transport ranks second as the means of cross-border travel. Air transport is also the main mode of travel used to access DRC and the island member states, although Mauritius has recorded some arrivals by sea. Rail transport accounts for an insignificant number of passenger traffic because the sector is underdeveloped.

The restructuring exercise SADC has embarked on includes the regeneration of all transportation infrastructures that provide access to major centres of population and economic activity of the region.

5.1.7 SADC road transport network

SADC (2009) indicates that the intra-SADC Regional Trunk Road Network (RTRN) totalled 62,000 km. A visual mapped presentation of the network is presented in Figure 5.6.



Source: Country Infrastructure Diagnostics (Africa Development Bank)

Figure 5-6 Intra-SADC road networks

The map above reflects a system that is fairly developed but disintegrated in certain parts of the region. Angola, DRC, Tanzania and Zambia seem to be the worst affected when it comes to access to other SADC member states.

Further to this challenge are the long distances between the major economic and population centres of the region. A quantitative analysis of the road distances between major cities in the region is presented in Table 5-3.

Table 5-3 Road transport distances between the major economic centres of SADC

Destination →

Origin ↓

	DAR	FIH	GBE	HRE	JNB	LAD	LLW	LUN	MPM	MSU	MTS
DAR											
FIH	5,056										
GBE	3,780	4,280									
HRE	2,634	3,403	1,147								
JNB	4,004	4,491	358	1,116							
LAD	5,538	939	3,341	3,147	3,552						
LLW	1,670	3,403	2,115	968	2,099	4,113					
LUN	2,134	2,922	1,636	481	1,583	3,404	709				
MPM	3,910	5,126	957	1,799	593	4,145	2,615	1,799			
MSU	4,200	4,971	702	1,561	438	3,990	2,537	2,167	853		
MTS	4,130	4,891	719	1,401	361	3,913	1,716	1,972	223	633	
WDH	4,936	3,124	1,156	2,029	1,367	2,185	2,395	1,650	1,960	1,716	1,728

Distances less than 1,000 kilometres

City Codes

DAR - Dar es Salaam, Tanzania
FIH - Kinshasa, Democratic Republic of Congo
GBE - Gaborone, Botswana
HRE - Harare, Zimbabwe
JNB - Johannesburg, South Africa
LAD - Luanda, Angola
LLW - Lilongwe, Malawi
LUN - Lusaka, Zambia
MPM - Maputo, Mozambique
MSU - Maseru, Lesotho
MTS - Manzini, Swaziland
WDH - Windhoek, Namibia

Source: created from distance tables from the various SADC countries

The results show that 79 per cent (52 out of 66) of the city connections are more than 1,000 km apart.

A calculation of the minimum road travel times between the major destinations, as presented in Table 5-4 reflects that on 73 per cent of the routes, it is not possible to complete the journey in a single day. The calculations were based on the following assumptions;

- Average speed 100km/hr (authorised speed in SADC is 120km/hr on motor way and 60-80km/per hour in towns and cities)
- Border delay allowances of 1 hour on each side

Table 5-4 Road travel times in hours between the major cities of SADC

Destination →

Origin ↓

	DAR	FIH	GBE	HRE	JNB	LAD	LLW	LUN	MPM	MSU	MTS
DAR											
FIH	54										
GBE	42	48									
HRE	32	38	13								
JNB	44	53	6	14							
LAD	59	11	37	35	42						
LLW	19	38	25	14	27	45					
LUN	23	31	18	7	20	36	9				
MPM	41	57	14	18	8	49	28	22			
MSU	48	58	11	20	6	48	29	26	13		
MTS	45	57	11	18	6	45	29	24	4	10	
WDH	56	35	14	24	16	24	28	19	24	21	21

Cities where one day travel by road is possible

City Codes

DAR - Dar es Salaam, Tanzania
FIH - Kinshasa, Democratic Republic of Congo
GBE - Gaborone, Botswana
HRE - Harare, Zimbabwe
JNB - Johannesburg, South Africa
LAD - Luanda, Angola
LLW - Lilongwe, Malawi
LUN - Lusaka, Zambia
MPM - Maputo, Mozambique
MSU - Maseru, Lesotho
MTS - Manzini, Swaziland
WDH - Windhoek, Namibia

This suggests that road transport though the main mode of travel currently in use could be a deterrent factor for the potential intra-SADC travel demand.

5.1.8 SADC rail network

In their latest report, the SADC Secretariat indicates that the Inter Regional Railway Network (IRRN) stands at 22,500 km. A mapped illustration of the regional rail network is presented by Figure 5-7. A visual inspection of the map confirms Schlumberger (2010)'s assertion that pre-independence surface transport links had not been designed to connect SADC countries. He argues they were created to facilitate access into landlocked countries and to transport minerals to sea ports.

Source: World Food Programme

Figure 5-7 SADC rail network

In most parts of the region rail transport links are non-existent. Luanda, Kinshasa, Windhoek, and Lilongwe do not have direct rail connections to any other economic and major population centre. Many of the existing connections such as the Dar es Salaam to Lusaka, and Harare to South Africa do not offer regular passenger services. In spite of the potential and huge developmental value for SADC's human and goods transportation requirements, the railway sector stands out as one of the most neglected industry.

5.2 Presentation of benchmarking results and analysis

This study uses four measures as the yardstick with which superior performance could be determined. These measures relate to the desired features of efficient networks described in chapter two. These are increased connectivity, improved accessibility, reduction in circuity and decrease in market concentration ratios (as measured by the HHI).

As explained in the methodology section, the abstraction of real-world network as graphs is used to present the extent of the actual transformative change that occurred on each intra-regional network. This is followed by a comparative analysis of achievements in terms of liberalisation-induced network changes between onset of reforms and post liberalisation era as at April 2011.The time of onset of reforms is dictated by the date on which legally binding regional civil aviation reforms became effective. For SADC the effective date was July 1998. Formal regional civil aviation reforms became legally binding later in MERCOSUR and ASEAN, in April 1999 and April 2005 respectively.

Changes in market concentration ratios were rated using different scales to those used by the U.S. Department of Transport. Given the reasons stated earlier that in air transport it is rare for the majority of city-pair markets to sustain many competitors, this study used three categories (competitive markets, markets with some competition and virtual monopoly) in evaluating concentration. These categories are explained in detail in section 5.7.2.1.

5.2.1 Results from graphed intra-regional networks

5.2.1.1 Intra-SADC liberalisation-induced network changes

The graphed intra-SADC network presented in Figure 5-8 reflects the loss of many direct air transport links with Harare and Manzini accounting for the highest number of the disconnectitions. Although the air transport network recorded two new city-pair connections, the loss of twelve direct routes had a negative effect of a total of ten disconnections.

It was surprising that some of the major cities that do not have direct air service connections have registered significant inter-country tourism flows. Mozambique and Zimbabwe recorded an increase in tourism but there is no direct air services connections between the capital cities of Maputo and Harare. Similarly, Mozambique and Malawi has registered growth in numbers visiting but there are no direct flights between the capital cities of Lilongwe and Maputo

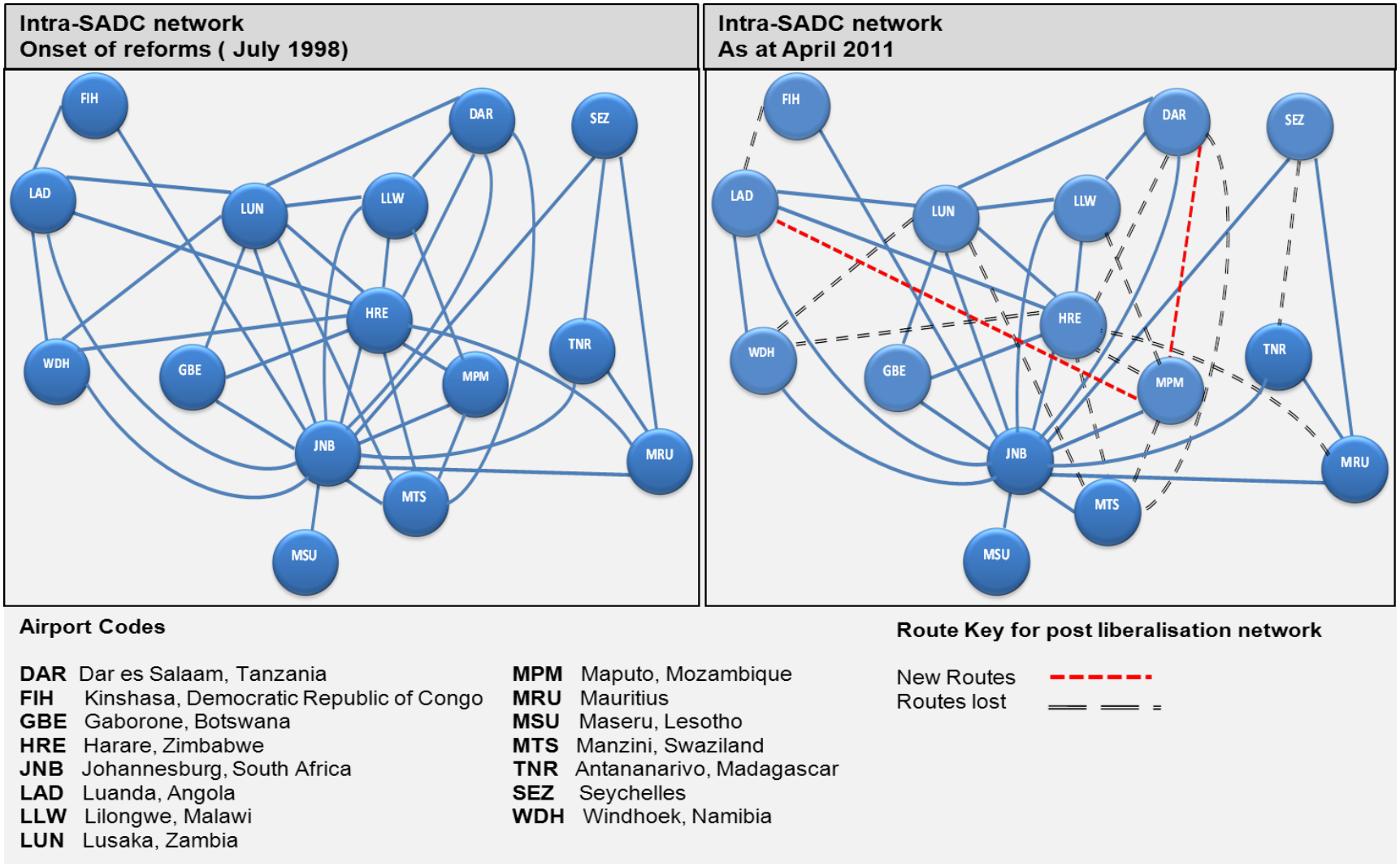


Figure 5-8 Comparison of intra-SADC network graphs at onset of reforms to post-liberalisation era

5.2.1.2 Intra-ASEAN liberalisation-induced network changes

The graphical presentation of the transformation that the intra-ASEAN network achieved is shown in Figure 5-9. The regional network registered no disconnection over the period April 2005 to April 2011. Vietnam accounted for three of the five new city-pair routes established over the study period.

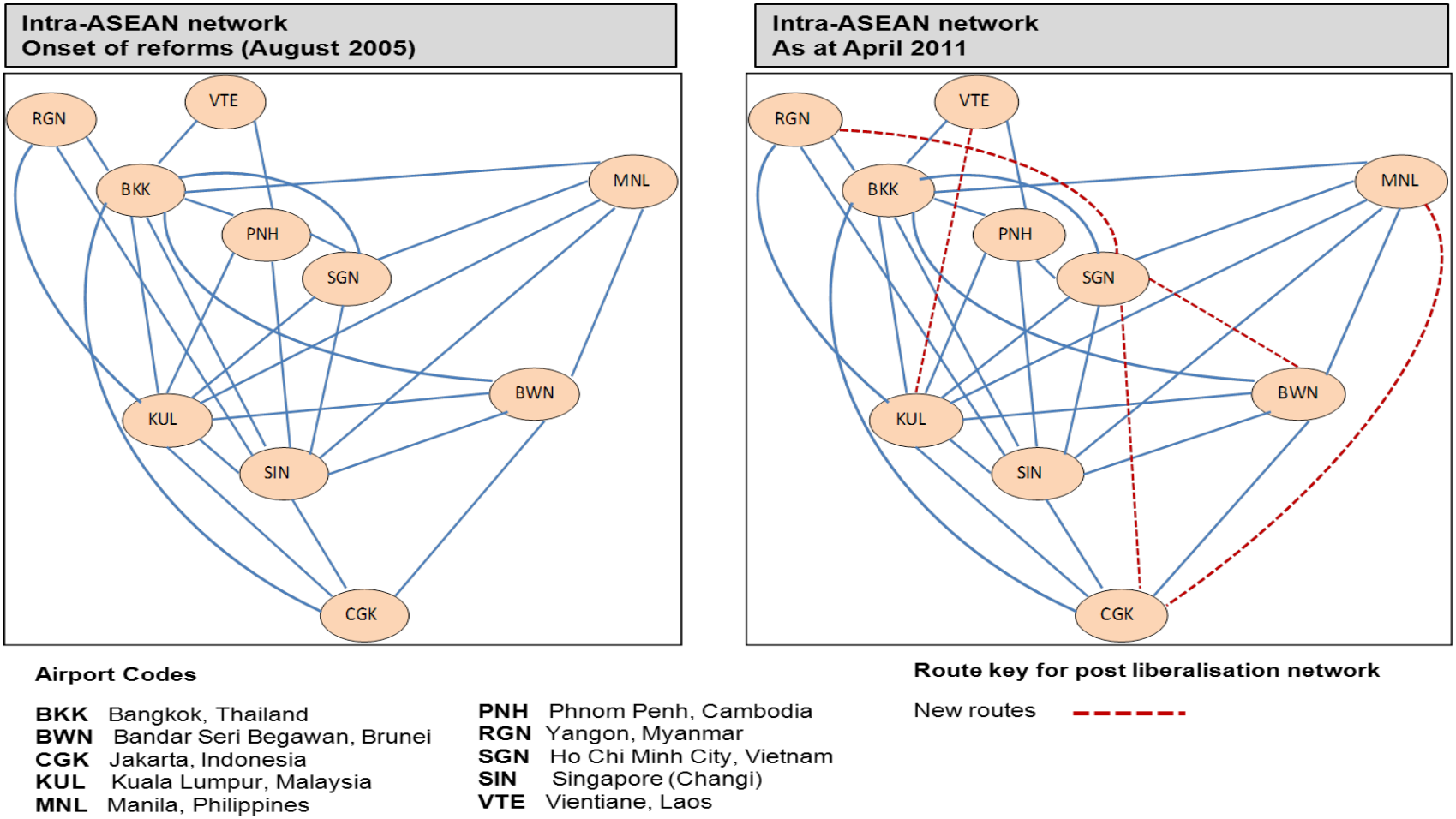


Figure 5-9 Comparison of intra-ASEAN network graphs at onset of reforms to post-liberalisation era

5.2.1.3 Intra-MERCOSUR liberalisation-induced network changes

The graphical presentation of intra-MERCOSUR network changes, shown by Figure 5-10 reflects that the region registered both losses and gains on direct air service connections. Compared to 1999 there were four new city-pair routes linking major population and economic cities of the region. Caracas (Venezuela) gained direct, nonstop connections to Quito (Ecuador) and Santiago (Chile). Lima (Peru) gained direct air service links to the Paraguay capital Asuncion and to Montevideo (Uruguay). At the same time, Bolivia's Santa Cruz lost its direct flight connections to Caracas (Venezuela) and Bogota (Colombia).

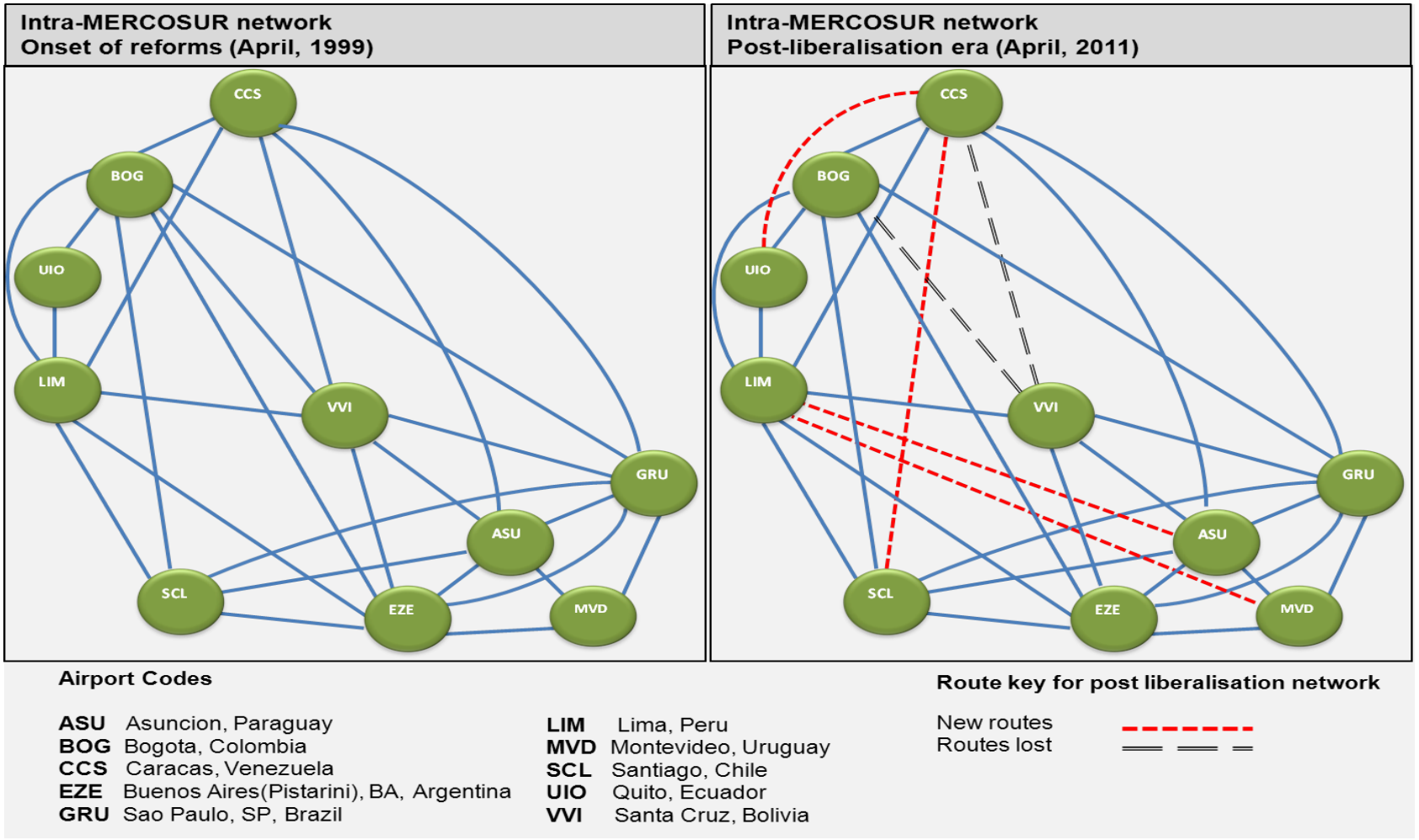


Figure 5-10 Comparison of intra-MERCOSUR network graphs at onset of reforms and post-liberalisation era

5.2.2 Results from benchmarking of spatial structure of SADC network

This section presents measures of connectivity, accessibility and circuity calculated for each of the three regional networks. Table 5-5 is an analysis of the results achieved by the intra-SADC network in comparison to the exemplar regions of ASEAN and MERCOSUR.

Connectivity indices reveal that the intra-SADC network when compared to ASEAN and MERCOSUR, suffered what Johnson *et al (*2011*)* describe as transformational demise. Instead of progression towards a maximally connected graph as is the case with the two exemplar regions, the intra-SADC graph reverses towards minimal connectivity. This is indicative of strategic drift or strategy execution failure in SADC. The discussions on possible reasons for reform policy failure are explored in detail in chapter seven.

Accessibility indices also worsened when compared to both ASEAN and MERCOSUR. It is however interesting to note that although the intra-MERCOSUR network registered improvements in the number of steps on the shortest path length, the loss of two Bolivian city-pair connections had a negative effect on that length in terms of kilometres. This is because of the geographical location of Bolivian airport on the intra-MERCOSUR air transport network.

The degree of circuity for SADC deteriorated significantly because of Harare‘s geographical position on the intra-SADC network. The ASEAN network realised significant reduction in circuity. MERCOSUR on the other worsened because of the topographical positioning of Santa Cruz airport.

Table 5-5 Results from benchmarking of connectivity, accessibility and circuity

MEASURES	REGIONAL INDICES						SUMMARY OF RESULTS ACHIEVED		
	INTRA-SADC NETWORK		INTRA-ASEAN NETWORK		INTRA-MERCOSUR NETWORK		SADC	ASEAN	MERCOSUR
Graph Theoretic Measures	Onset of reforms July 1998	Post liberalisation era April 2011	Onset of reforms August 2005	Post liberalisation era April 2011	Onset of reforms April 1999	Post liberalisation era April 2011			
Changes in Connectivity									
Alpha (α)	26 per cent	15 per cent	50 per cent	64 per cent	56 per cent	61 per cent	Negative	Positive	Positive
Beta (β)	2.53	1.87	2.7	3.2	2.9	3.1	Negative	Positive	Positive
Gamma (γ)	36 per cent	27 per cent	60 per cent	71 per cent	64 per cent	69 per cent	Negative	Positive	Positive
Theta (θ)	3,589 kms	2,821 kms	3,469 kms	4,349 kms	6,522 kms	7,179 kms	Negative	Positive	Positive
Changes in Accessibility									
Shimbel Index	344 steps	364 steps	126 steps	116 steps	126 steps	118 steps	Negative	Positive	Positive
L-Matrix	527,304 kms	571,420 kms	145,036 kms	139,474 kms	251,464 kms	257,450 kms	Negative	Positive	Negative
Changes in Circuity									
Degree of Circuity	715,024 kms	1,112,929 kms	75,273 kms	17,737 kms	24,209 kms	95,925 kms	Negative	Positive	Negative

5.2.2.1 Results from benchmarking market concentration ratios

This study categorised market concentration into three statuses, namely

a) Low concentration (competitive market,)
b) Moderate concentration (market with some competition) and
c) High concentration (virtual monopoly).

The classification which Table 5-6 explains centred on number of airlines on a city-pair and the size of their market share.

Table 5-6 Market concentration categorisation

Category	Low concentration Competitive market	Moderate concentration Market with some competition	High concentration Virtual monopoly
Number of airlines on a city-pair	≥ 4	≥ 3	≤ 3
Herfindalh-Hirschman Index range (0-10,000)	≤ 2,500	> 2,500 ≤ 3,800	> 3,800

Given the reason for liberalisation is to reduce market barriers and induce competition, this study considered competition to exist when a city-pair moved away from being served by a single airline to multiple designation. A route was therefore considered to be competitive when there were more than three airlines on a city pair. In the event that a route had more than three airlines concentration was still considered high in cases where any one of the incumbent carriers dominated the market i.e. if they held more than 50 per cent of the market share. The upper limit for moderate competition on a liberalised city-pair is assumed to result from a scenario where the market share distribution is 50, 30, and 20. This is how this research arrived at an HHI of

3,800 as the cap for moderate concentration and threshold for high concentration.

The upper limit for low concentration, which the study considered as the threshold for moderate concentration was a scenario where a city-pair had four airlines with equal market shares. This would mean market shares of 25 per cent and this was how the study derived 2,500.

The gaps in the SADC network were therefore not only determined by the number of city-pairs that got more than three competitors, it also considered how the market shares on those routes were distributed.

The results of the market concentration benchmarking exercise are presented by scatter diagrams in Figure 5-11 to 5.13. The vertical axis of the scatter diagram represents the HHI levels that were calculated for all the sets of city pairs that had direct air service connections between each other. On the horizontal axis of the diagrams are the set of routes that had more than two airlines over the period under review.

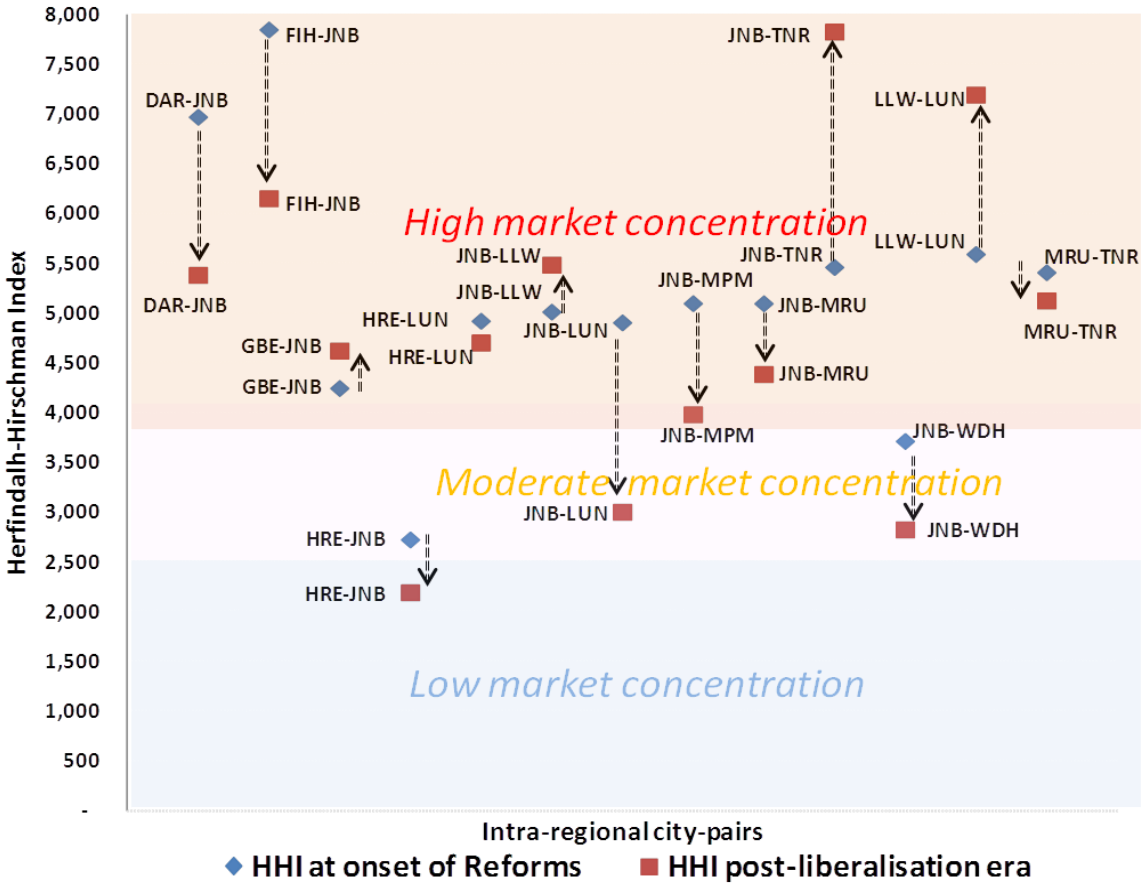


Figure 5-11 Comparison of SADC market concentration ratios at onset of reforms and post-liberalisation

At onset of reforms SADC had two city-pair connections that had moderate concentration. These are Harare-Johannesburg and Johannesburg-Windhoek. The two routes' HHI improved with the Harare-Johannesburg progressing to low market concentration.The only city-pair that had no competion prior to liberalisation and realised a signifiant improvement in HHI and progressed into moderate concentration is Johannesburg-Lusaka. Futhermore competition on most intra-SADC city-pairs that have more than two carriers, is characterised by dominance by one carrier.

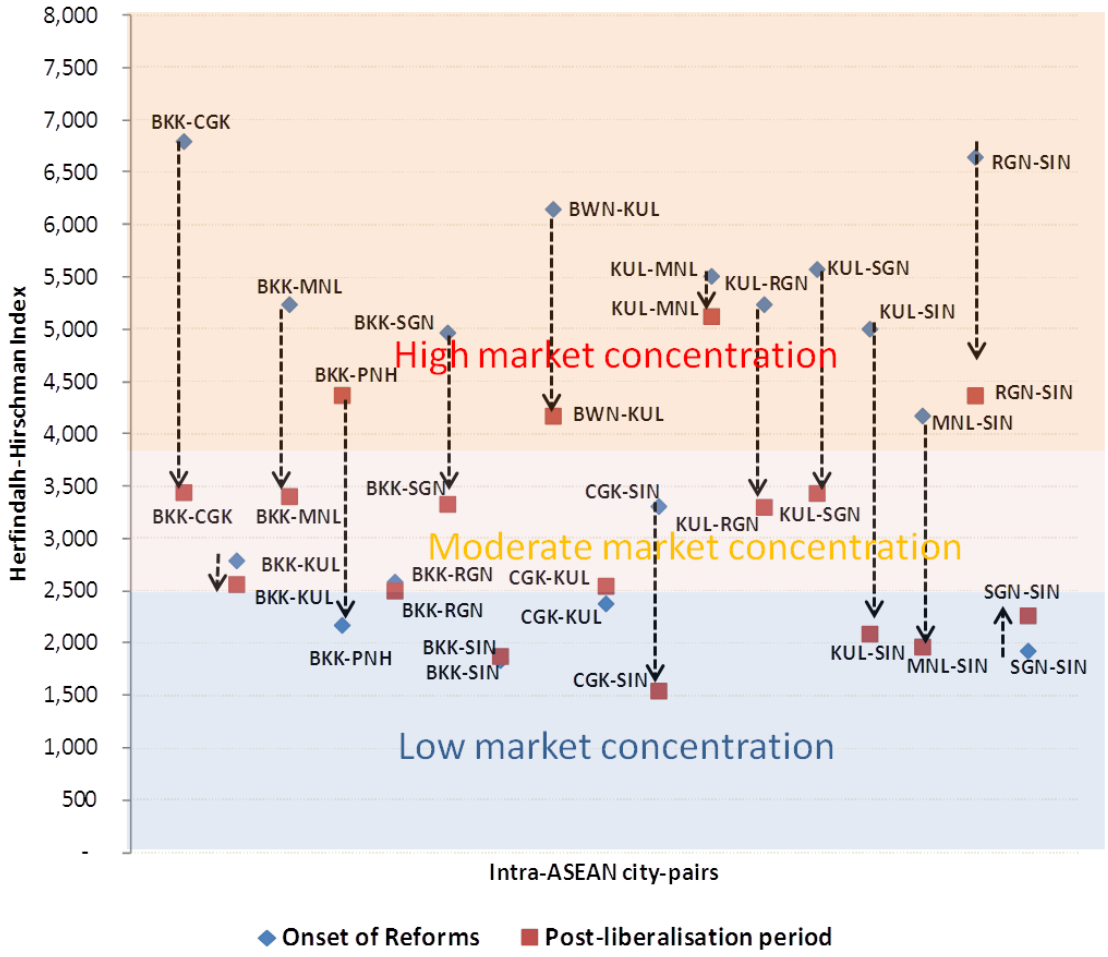


Figure 5-12 Comparison of ASEAN market concentration ratios at onset of reforms and post-liberalisation

Figure 5.12 shows that ASEAN's reforms witnesssed an increase in competitive routes from 7 to 13. Some of the largest gains on the intra-ASEAN network are those city-pairs linking Changi (Singapore) to Kuala Lumpur (Malaysia), Manila (Phillipines) and Jarkata (Indonesia)

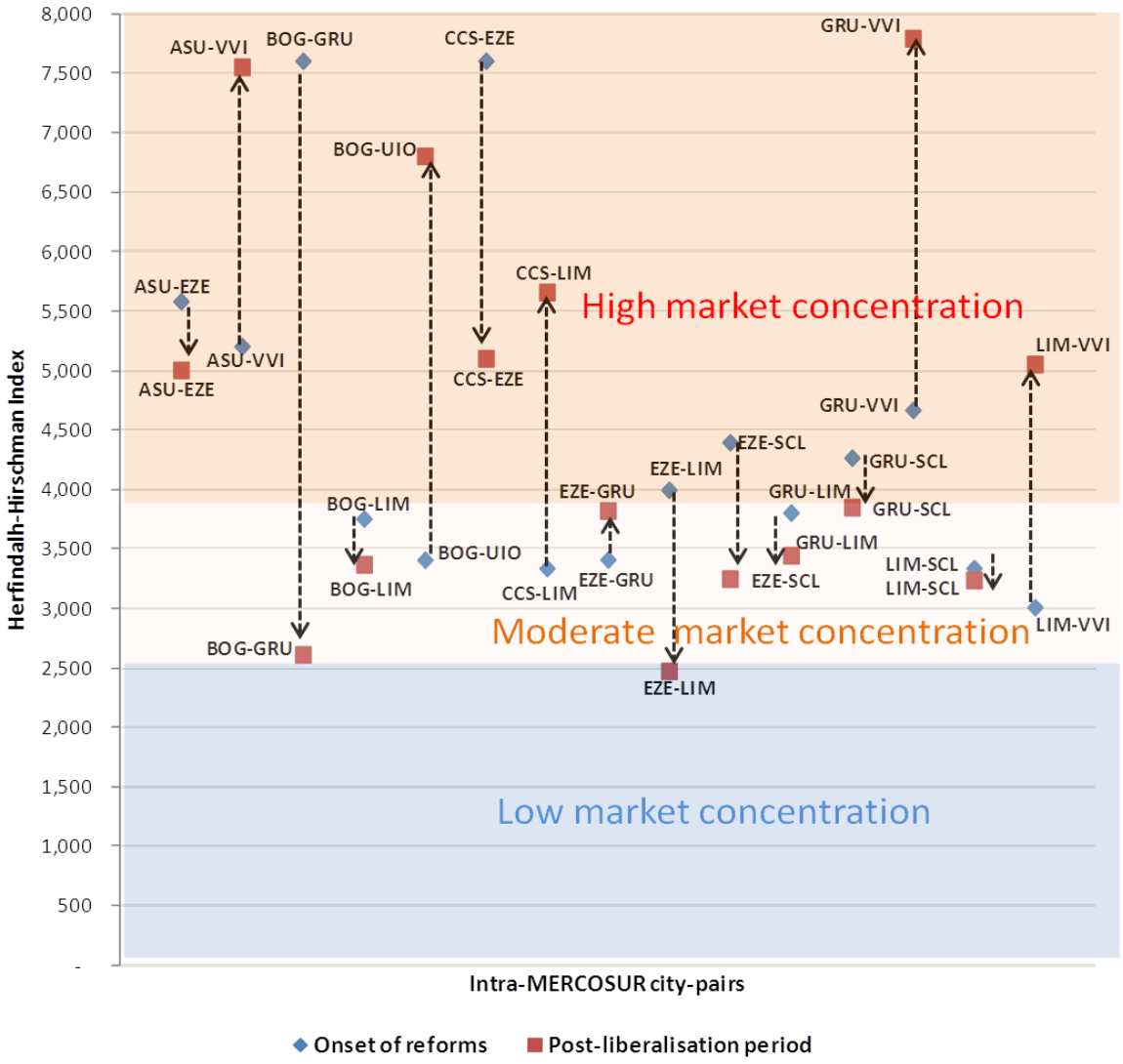


Figure 5-13 Comparison of MERCOSUR market concentration ratios at onset of reforms and post-liberalisation

MERCOSUR reforms on the other hand, as reflected in Figure 5-13, witnessed mixed results. Although it has a higher number of competitive routes than SADC, the competitiveness of the city-pairs was affected by the airline mergers and acquisitions that characterised the intra-MERCOSUR air transport market over the period 1999 to April 2011. Notable improvements on the intra-MERCOSUR network were witnessed on the route linking Sao Paulo (Brazil) to Bogota (Colombia) as well the link between Buenos Aires(Argentina) and Lima (Peru).

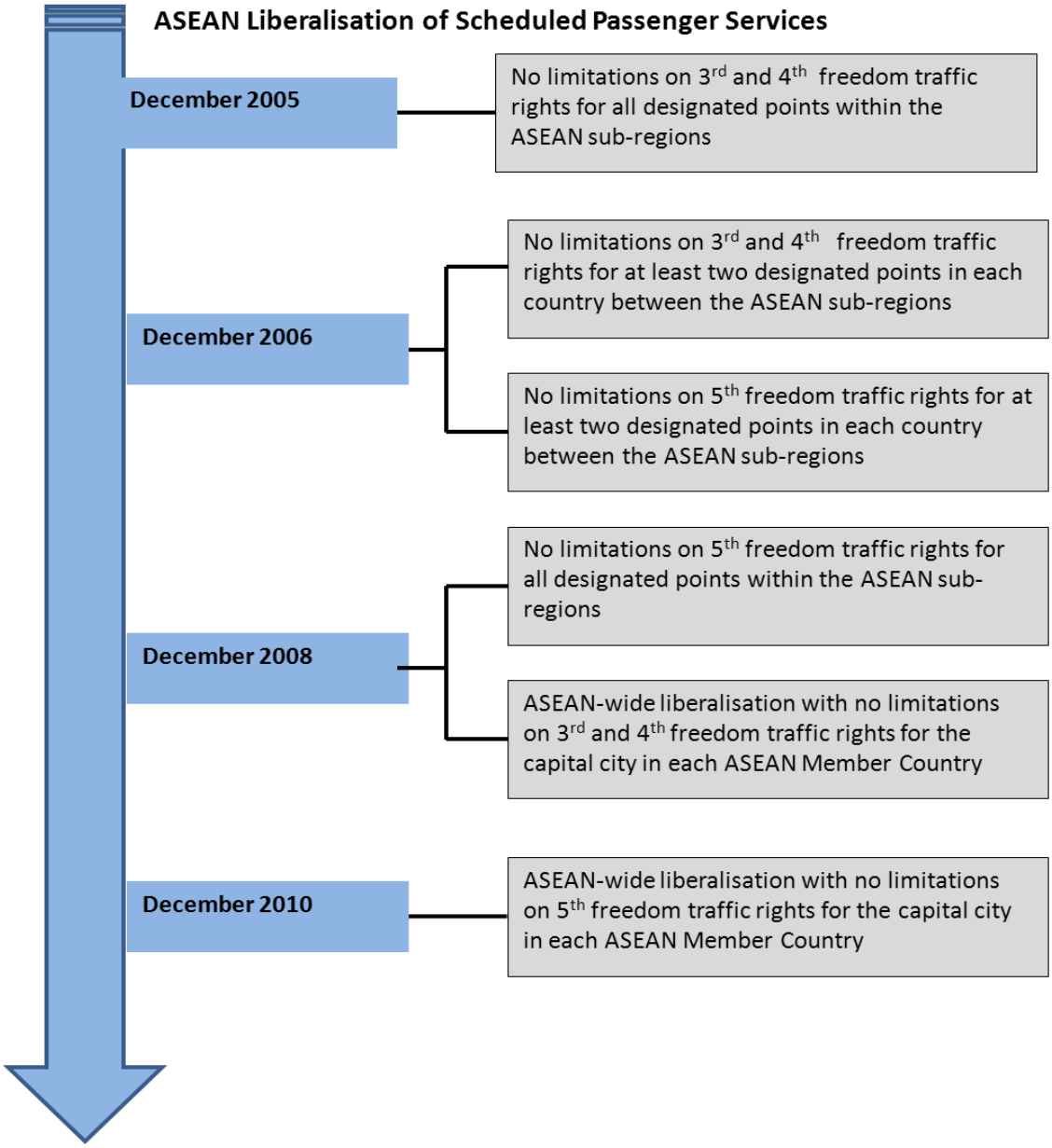
From the summary of results observed on the liberalisation-induced changes in market concentration on the three regional airline networks, one can conclude that SADC nationals and visitors to the region have limited choices when compared to those travelling within other regions particularly ASEAN. With only 3 city-pairs out of 28 that had low to moderate concentration, the results show that SADC trails behind ASEAN and MERCOSUR.

5.2.3 Analysis of air transport liberalisation in ASEAN and MERCOSUR

Theory on liberalisation has put forward four main pillars as necessary and sufficient conditions for successful implementation of air transport liberalisation strategies (Morrell, 2009; Williams, 2002; Doganis, 2010). These are multiple designations of airlines, liberal exchange of traffic rights (particularly fifth freedom), removal of restrictions of foreign ownership in airlines and fair competition regulations.

5.2.3.1 Execution of air transport liberalisation strategy in ASEAN

The ASEAN is yet to open its skies completely and restrictive airline ownership clauses still exist amongst member states. Instead of a centralised regulatory authority for enforcement and oversight of competition regulations, the region still relies on consensus. There is empirical evidence however that traffic rights and multiple airline designation were core to the implementation of air transport liberalisation in ASEAN. This also formed the basis on which progress was monitored and evaluated as is reflected by Figure 5-14



Sources: Data gathered from ASEAN Secretariat

Figure 5-14 Implementation of air transport reforms in ASEAN

A sample of two city-pairs randomly drawn from those routes that are characterised by low market concentration in ASEAN is presented in Table 5-7. A scrutiny of the place of business of the carriers, their ownership structure and business model suggests that the improvement of competiveness of city-pairs in ASEAN is a result of multiple designations of airlines, the exchange of unrestricted fifth freedom traffic rights within the region and the lifting of barriers to entry for low cost carriers on dense routes.

Table 5-7 Insight into air transport liberalisation in ASEAN

Airline	Country of registration	Ownership structure	Business model	Status post - liberalisation	Stock exchange listing
Jakarta-Singapore(CGK-SIN)					
Garuda(GA)	Indonesia	State & public	FSC	Active	IDX
Jetstar Asia (3K)	Singapore	Private & Qantas	LCC	Active	None
Lion Air (JT)	Indonesia	Private	FSC	Active	None
Philippine Airlines(PR)	Philippines	Private	FSC	Active	PSE
Indonesia AirAsia (QZ)	Indonesia	Associate of AirAsia	LCC	Active	None
Mandala Airlines (RI)	Indonesia	Private	LCC	AOC suspended	None
Singapore Airlines(SQ)	Singapore	Private	FSC	Active	SGX
Tiger Airways (TR)	Singapore	pan-Asian airline	LCC	Active	SGX
Valuair (VF)	Singapore	part of Jetstar Asia	Hybrid	Active	None
Batavia Air (BTV)	Indonesia	Private	FSC	Active	None
Adam Air(KI)	Indonesia	Private	LCC	Defunct	N/A
Bangkok-Singapore (BKK-SIN)					
Thai AirAsia (FD)	Thailand	Associate of AirAsia	LCC	Active	None
Singapore Airlines(SQ)	Singapore	Private	FSC	Active	None
Thai Airways (TG)	Thailand	State & public	FSC	Active	SET
Tiger Airways (TR)	Singapore	pan-Asian airline	LCC	Active	SGX
Jetstar Asia (3K)	Singapore	Private & Qantas	LCC	Active	None
Myanmar Airways (8M)	Myanmar	Private	FSC	Active	None
Valuair (VF)	Singapore	part of Tiger Airways	Hybrid	Services withdrawn	None
Air Andaman (2Y)	Thailand	Private	FSC	Defunct	

Stock Exchange Symbols

IDX - Indonesia Stock Exchange

PSE - Philippine Stock Exchange

SET - Stock Exchange of Thailand

SGX – Singapore Stock Exchange

Even though ASEAN is yet to lift restrictions on foreign ownership in airlines they have permitted significant cross-border airline investment deals through the use of the principal place of business principle. AirAsia, a Malaysian based airline and one of the fastest growing low-cost carriers in ASEAN has taken advantage of this to expand its operations across national borders. Its affiliates, Thai AirAsia and Indonesia AirAsia are major players on the intra-ASEAN regional network. Another carrier Jetstar, an Australian based company whose subsidiary Jetstar Asia is a joint venture with Singaporean based investors has

adopted the same strategy. Tiger Airways is another example of an airline that has entered new markets using the same strategy.

Policy makers in ASEAN allowed low cost carriers to enter routes that were once the preserve of full service carriers. The result was intense rivalry even for dominant carriers like Singapore Airlines, who though recognised as one of the best performing airlines in the world conceded that there was stiff competition. Singapore airlines have responded to the market rivalry in their key regional markets by forming their own low cost subsidiary and investing in associate companies. They have launched SilkAir and have also invested in an associate airline, Tiger Airways. One result of the intensity of rivalry from low cost carriers on Singapore airlines is the fact that they have reduced frequencies and bolstered their low cost subsidiary and associates on those city-pairs where competition from low cost carriers is stiff. This strategy is noticeable on the Bangkok-Singapore and Kuala Lumpur (KUL-SIN) city-pairs where Tiger Airways and SilkAir are major players.

The ASEAN has also witnessed mergers and acquisitions within the regional airline industry as weak airlines realised the need for consolidation and the strong carriers seek to enter markets where some restrictions exist. Valuair merged with their competitor Jetstar Asia to survive competition. To Jetstar Asia the strategic advantage of this merger was the possibility of serving the Indonesian market despite restrictions on traffic rights.

The potential to grow and broaden sources of finance, that air transport liberalisation has unlocked for the ASEAN airline industry is mirrored in the number of airlines that have managed to meet the stringent requirements for public listing on stock exchanges.

5.2.3.2 Execution of air transport liberalisation strategy in MERCUSOR

There is empirical evidence in IATA commissioned studies and in the current levels of competition and airline participation on city-pairs that although bilateral agreements still form the basis of exchange of airline services between member

states in MERCOSUR, all countries have migrated to multiple designation of airlines in their BASAs (IATA, 2009). With the exception of Bolivia where some of its ASAs had no provisions for 5th freedom traffic rights many of the member states exchange such rights.

A sample of two city-pairs randomly selected on the basis that they lie in the low to moderate concentration is presented by Table 5-8.

Table 5-8 Insight into MERCOSUR air transport liberalisation strategy

Airline	Country of registration	Ownership structure	Business model	Status post - liberalisation	Stock exchange listing
Bogota-Sao Paulo (BOG-GRU)					
Avianca (AV)	Colombia	Private	FSC	Active	BVC
TAM Linhas Aereas (JJ)	Brazil	Private	FSC	Active	BM&FBOVESPA, NYSE
Varig (G3)	Brazil	part of Gol Airlines	FSC	Active	BM&FBOVESPA & NYSE
OceanAir (06)	Brazil	part of Avianca	FSC	Active	parent on BVC
Buenos Aires – Lima (EZE-LIM)					
Aerolineas Argentinas (AR)	Argentina	re-nationalised	FSC	Active	None
Lan Peru (LP)	Peru	part of LAN Airlines	FSC	Active	Parent co on NYSE
LAN Argentina (4M)	Argentina	part of LAN Airlines	FSC	Active	Parent co on NYSE
LACSA (LR)	Costa Rica	part of Avianca	FSC	Active	parent on BVC
TACA Peru (TO)	Peru	part of Avianca	FSC	Active	parent on BVC

Stock Exchange Symbols

BVC - Colombia Stock Exchange **BM&FBOVESPA** - São Paulo Stock Exchange **NYSE** – New York Stock Exchange

As is the case with ASEAN, MERCOSUR has witnessed a marked increase in low cost carriers with Gol Airlines, a Brazilian carrier as one of the best examples. Member states of MERCOSUR have also allowed cross border airline ownership and airline consolidation. An example is LAN Airlines, a Chilean airline that has a number of subsidiary carriers operating in other member states i.e. LAN Argentina, LAN Ecuador and LAN Peru.

However unlike the ASEAN, consolidation in the airline industry in MERCOSUR has involved the major players. For the period under review, three notable mergers and acquisitions observed relate to the following:

- Merger between TAM (Brazil) and LAN (Chile)
- Merger between Avianca (Colombia) and TACA a regional grouping of airlines in South America, and
- Acquisition of Varig by Gol Airlines

The incidences of mergers and acquisitions have to some extent however had the negative effect of increasing market concentration on intra-regional routes.

The dual listing of some of the airlines on stock exchanges in their countries and on the New York stock exchange (NYSE) speaks volumes about their size and capacity. IATA (2010) observe that the TAM (Brazil) and LAN (Chile) merger will create a company whose market capitalisation is worth US$14 billion; a figure surpassing that of BA/Iberia (US$5 billion) and KLM/Air France (US$10 billion).

5.2.4 Gaps existing in SADC's strategy execution

Whilst the air transport liberalisation strategy that SADC is using shares the same features as those of exemplar organisations, there is a complete disconnect between the region's strategy and its implementation.

Although SADC is in a similar situation as ASEAN and MERCOSUR on open skies, foreign ownership restrictions and competition regulations, the region falls far short on traffic rights, high entry barriers for low cost carriers and the insignificant participation of the private sector in the regional air transport market.

Unlike the exemplar regions of ASEAN and MERCOSUR, fifth freedom traffic rights among SADC states are uncommon in contrast to what is stated in the YD. Although there is empirical evidence that domestic aviation markets in many of the SADC countries have been deregulated (Williams, 2002;

Mutambirwa and Taunton, 2000; Schlumberger, 2010) there is glaring absence of low cost carriers even on those city-pairs considered to have low and moderate market concentration. A few countries have inhibited competition by barring private sector players from participating on the intra-regional market.

The concentration of traffic around Johannesburg suggests the combination of third and fourth traffic rights by South African Airways and their strategic partners in a bid to overcome the complications of obtaining fifth freedom traffic rights.

5.2.5 Best practice from ASEAN and MERCOSUR

Although the exemplar regions still fall short on complete open skies policies, restrictions on foreign ownership in airlines and the absence of a centralised regulatory authority for oversight and enforcement of competition policy, there are many lessons that SADC can reflect on. These relate to the following:

a) The positive effect of liberal exchange of traffic rights on continued airline services provision in the event of withdrawal or demise of incumbent carriers.
b) The positive impacts of multiple designations on uninterrupted provision of services and innovative competition as airlines become wary of loss of market share.
c) The pecuniary gains ensuing from fostering a competitive environment for the airline industry as incumbents, faced with intense rivalry from new entrants, are encouraged to improve their operations and to co-operate with other airlines. Those that are weak are forced to consolidate. This in turn ensures a healthy airline industry for the benefit of both the consumer and the airlines

5.3 Conclusion

This chapter sought first to establish whether strategy execution in SADC met the requirements necessary for effective implementation of air transport liberalisation. Where the execution of the strategy was shown to be weak or ineffectual, a second objective was to suggest what improvements might be made to achieve the required goals of air transport liberalisation.

SADC was shown to offer a similar socio-political and economic environment for air transport liberalisation to that of the MERCOSUR and ASEAN regions. An assessment SADC's socio-economic indicators and modes of travel available within the region provided ample evidence that the propensity to use air travel exist.

A benchmarking exercise comparing development of SADC's air transport network under a liberalisation process, with the development of MERCOSUR and ASEAN networks, suggested the intra-SADC network structure is heading towards a state of stagnation instead of improving, while both MERCOSUR and ASEAN networks demonstrate clear signs of improvement.

Best practice identified with reference to the way successful air transport liberalisation strategies have been implemented in MERCOSUR and ASEAN regions was used to identify potential areas of improvement to SADC performance. The study identified the gap in strategy execution in SADC as the failure to designate sufficient airlines, restrictions on traffic rights, weak private sector participation and the tendency to stifle competition. If SADC was to take a leaf from the two exemplar regions the air transport restructuring strategy might deliver the stated goals. What the study still needs to consider is whether there was sufficient demand to justify private sector participation and the reasons underlying reform failure. This is what the next chapters seek to unravel.

6 Chapter Six: Estimating demand for air travel on the intra-SADC network

6.1 Introduction

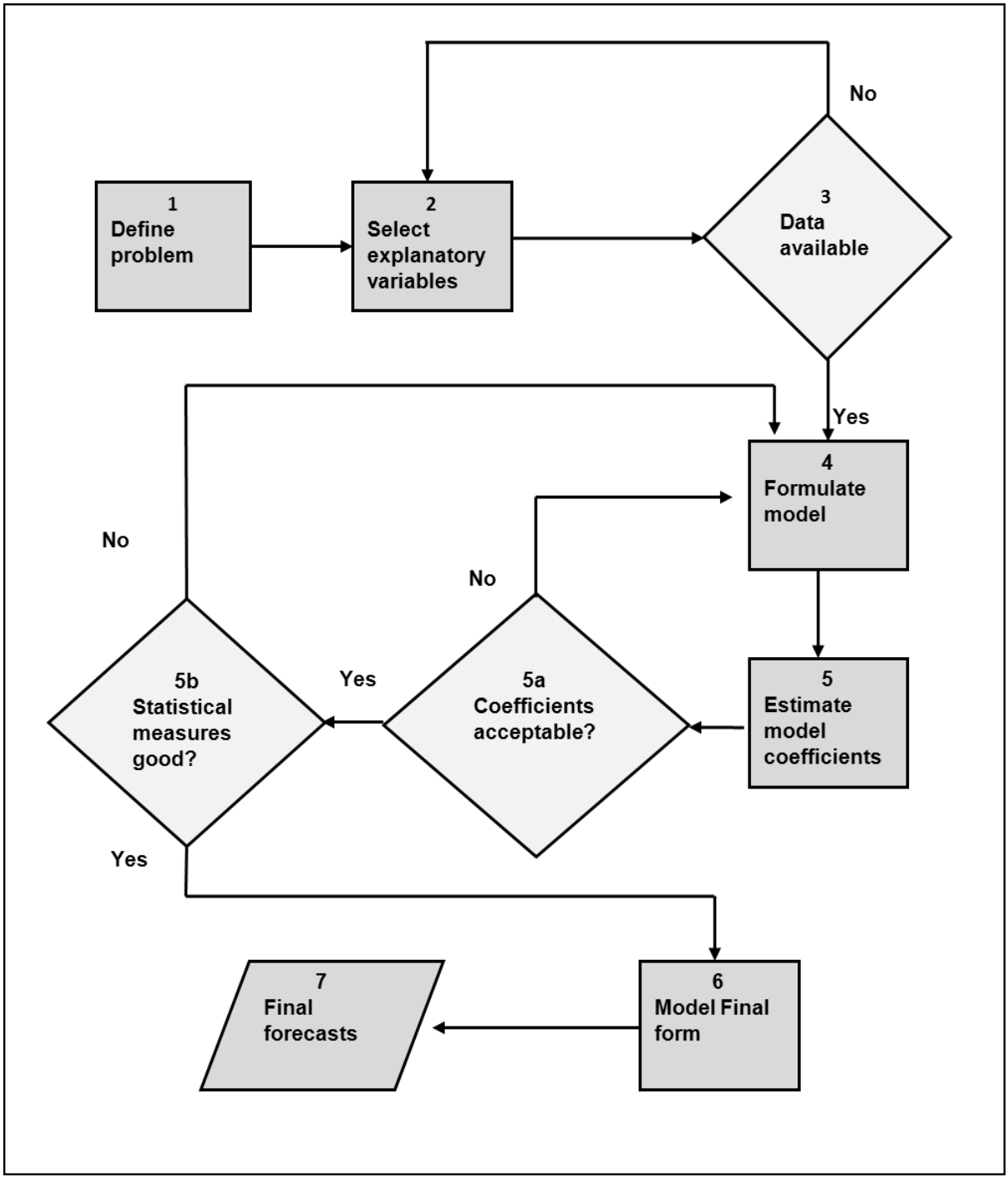
This chapter presents the econometric model developed by this study for the purpose of analysing demand patterns in air passenger services on the intra-SADC network. The intention was to determine whether the volume of passenger traffic was sufficient to justify direct flight connections between capital-city pairs with no such connections. The overriding objective was the identification of new potential routes with sufficient demand to help reduce the gap identified from the benchmarking exercise in the preceding chapter. This chapter describes the approach adopted in building the SADC model and documents the final model the study utilised in producing demand estimates on those city-pairs that has no air service between them in December 2009.

6.2 Model development

The study adopted the seven stage process that is grounded in econometric modelling theory and is recommended by ICAO (2006) for estimating demand for air transport. The seven stages that are listed below are:

a. Definition of the problem
b. Selection of the relevant causal or explanatory variables
c. Establishment of the availability of data or the selection of substitutes or proxy variables if such data are not available.
d. Formulation of the model specifying the type of functional relationship between the dependent variable and the selected explanatory (causal) variables.
e. Model estimation that entails carrying out an analysis to test the relationship being hypothesised, including the estimation of the model coefficients, their magnitudes, signs and statistical measures.
f. Establishment of the model in final form
g. Use of the model to predict dependant variable.

Though presented in a systematic way certain stages of econometric models are characterised by iterative procedures as is shown in Figure 6-1.



Source: Adapted from ICAO (2006)

Figure 6-1 Developing an econometric model

6.2.1 Definition of the problem and dependant variable

The econometric model that was developed for the intra-SADC network is purpose driven. The goal is to predict the volume of weekly passenger traffic between SADC's major economic centres, using a number of explanatory variables (socio-economic and other indicators) that are known (empirically) to have an influence on demand for air travel. The model is therefore designed to estimate the volume of passenger flows between a set of origins and destinations that do not have direct flights between them. Most of these city-pairs have never had direct flights and thus have no historical data on which to base estimates.

The variable that is being predicted or the dependant variable (denoted by $\boldsymbol{y}$) for the SADC model is therefore the volume of weekly passenger traffic linking the major city-pairs of SADC.

6.2.2 Selection of explanatory variables

The manner in which explanatory variables ($\boldsymbol{x}_S$) were selected was informed by literature review on the factors that have been known to influence demand for air travel. The variables postulated to be good predictors of demand for air travel are primarily geographical and socio-economic indicators such as distance, demographics, income, and the cost of air travel (Grosche et al, 2007). Stochastic and random events such as political instability and epidemics have also featured (Vasigh et al, 2008; Adler and Hashai, 2005).

A number of authors suggest two approaches to selecting explanatory variables for an econometric model. One method is to start with a long list and the other is to settle for a few variables that are known to be the most relevant in predicting the dependent variable (Hair et al, 2010; Mendenhall and Sincich, 2003). Greene (2008) argues that a model can never truly be confirmed unless it is made so broad as to include every possibility. Verleger (1972) notes that whatever method is adopted, the goal must be to select explanatory variables that are highly correlated with air travel but are not correlated with each other.

This is because correlation between explanatory variables in an econometric model causes multicollinearity which in turn may interfere with statistical inference.

Ten explanatory variables were identified as potential predictors of the size of demand for O/D air passenger travel within SADC. Five variables, three quantitative and two qualitative, were hypothesised as having positive (generative) effect. These are population, income, trade, tourism, shared borders and shared language. Two variables (one quantitative and the other qualitative) were presumed to impede air travel demand. These are distance and inter-country travel restrictions. Two qualitative variables, HDI and PSI, whose influence could be either way, were also suggested.

6.2.2.1 Population

The population variable which theoretically and empirically represents the size of the potential of the air travel market has been applied differently in various econometric models. Some have used country population (Adler and Hashai, 2005) others airport catchment (Hazledine, 2009; Matsumoto, 2007) and another group has made use of airport passengers (Doganis, 2004). Country populations were considered inappropriate for analysing air travel demand because of inequalities in income distribution. Air travel in most SADC member states is concentrated around one or two airports. Catchment data is difficult to determine as passenger choices are limited to those airports designated to serve the intra-regional network. Given the restrictions that still exist on the airports that are permitted to receive intra-regional and international traffic, the study considered passenger numbers at airports as the most appropriate proxy for the population variable.

The airport passenger population variable included domestic, regional and international passengers. Passengers making connecting flights were included whilst those continuing their flight on the same aircraft were excluded to avoid double counting.

Specifying a model with passenger traffic on both side of the equation has its own drawbacks. The use of total observed passenger traffic at airports on the right hand side of the equation as the proxy for the urban population creates complications when forecasting global demand potential between countries.

As for this study, the research question addresses route connectivity potential, not global demand. Given the difficulties the current travellers are facing with connectivity, the question focuses on whether from the current air travel traffic volumes there is adequate demand, at city-pair level to justify direct flights on those markets that currently do not have direct connections. The use of airport passengers on the right hand side was therefore considered appropriate. Observed airport traffic in this study is equivalent to airport catchment area. This is because international air transport in most SADC countries is concentrated at one designated airport.

6.2.2.2 Income

Income has been shown to have a positive correlation with demand for air travel (Vasigh et. al, 2008; Grosche et al, 2007). This variable has been used in econometric models in various forms. In some situations it has been represented by disposable income, GDP, and per capita income (where gross income is divided by a country's total population). Data on disposable income is not available in SADC countries. As a measure of economic activity of a country, using GDP as a proxy measure for income is negatively affected by the dependence on agriculture; by half of the member states. This study opted for the income measure that the World Bank uses to determine the standards of living and the stages of economic development of countries. This measure is GNI per capita.

6.2.2.3 Trade

Demand for transport is derived demand arising out of economic, social or personal activities (O'Connor, 1982; Bell and Lida, 1997; Janic, 2007). One such activity is the economic activity of trade and investment. For the SADC

where travel by surface transport is hindered by underdeveloped infrastructure, trade was considered a potential predictor of air traffic volumes between member states. Given the low levels of access to the internet it is assumed that a significant amount of trade involves face to face interactions.

6.2.2.4 Tourism

Bieger (2006) argues that tourism is a driving factor for and, in some cases, a stimulator of change in air transport. Tourism in SADC is growing and the assessment of tourism flows to the region that was done in chapter 5 shows that a significant number of visitors within the region rely on air transport for intra-SADC travel. The study considered tourism a candidate for inclusion in the model.

6.2.2.5 Shared borders and language

These two qualitative variables are premised on the assumptions that migration patterns in the region are shaped by shared cultural values whose proxies are shared borders and similarities in languages. This was the same approach used in Hazledine (2009) study. Those visiting friends and relatives are likely to visit neighbouring countries and those countries with which they share languages. It is also assumed that business relations are likely to be higher between those countries that share the same language. The two variables were entered into the econometric model as dummy variables where 1 represents shared border or language and 0 indicates otherwise in both cases.

6.2.2.6 Distance

Of the number of factors that are known to affect propensity to travel; distance, travel time and air fares are usually used. Literature on air transport demand cites distance between cities as an important geographical factor affecting inter-city air travel demand (Grosche et al, 2009). On city-pairs dominated by business travel, travel time is usually considered as the major cost element in the analysis of air transportation. However for the intra-SADC network, where the focus is on direct connections between major cities, distance and travel time

are assumed to serve the same purpose. The other consideration was that using these two variables in the same model could potentially cause multicollinearity. Airfares are omitted because appropriate data is unavailable.

This study acknowledges the impact the omission of air fare variable is likely to have on the results of the econometric model. This is because demand for air travel is known to be sensitive to air fares and high fares are known to suppress demand. Overlooking air fare in an econometric model might therefore produce a model that fails to adequately forecast potential demand for air travel.

This research is however cognisant of the fact that the sensitivity of airline passengers to air fares (demand elasticity) varies across geographic regions and the importance of air fares within the overall cost of travel. In a 2008 study carried out by InterVistas, IATA established that the intra Sub-Saharan Africa region, with an elasticity multiplier of 0.6, had a relatively inelastic demand. They attributed this to the fact that African economies have a much smaller middle class and travel is concentrated among higher income individuals who are less sensitive. This assertion is corroborated by the profile of passengers on regional flights highlighted in 2.2. The dominance by VFR and business travellers at the expense of tourism suggests essential rather than cost-based demand for air travel. This study therefore concluded that the omission of air fares in the SADC model would not have a huge impact on the predictive ability of the gravity model.

6.2.2.7 Travel Restrictions

Inter-country travel restrictions relate to visa requirements for SADC nationals travelling on the intra-SADC network. It is assumed that visa requirements would negatively affect volume of weekly passenger traffic between those countries with such restrictions. This explanatory variable entered the econometric model as a dummy with 1 indicating the existence of travel restrictions and 0 otherwise.

6.2.2.8 Human development

Schlumberger (2010) argues that air transport is still regarded as a preserve for the rich in sub-Saharan Africa. This arises from poverty levels that have remained high. Despite the fact that countries are registering significant real GDP growth rates, poverty levels have continued to worsen. This study assumes that the socio-economic progress of a country as measured by the HDI influences demand for air travel. The compelling reason for its inclusion is the UN's argument that national wealth is not evenly distributed amongst the citizens of any nation. This argument is supported by the high Gini index[7] measures recorded for most of the SADC countries in the World Bank Development Indicators database.

6.2.2.9 Political stability

Vasigh et al (2008) attribute low passenger air traffic in some of the African to political conflicts. Political instability as shown in Chapter 5 looms large in many SADC countries. It is also interesting to note that one of the original objectives for the establishment of this regional economic community was trying to find solutions to political instability. This research considered this variable an ideal candidate for inclusion in a model aimed at predicting air passenger traffic between city-pairs in SADC.

6.2.3 Data availability

The validity of the propositions of a model is measured against the behaviour of observed data or experimental data (Mendenhall and Sincich, 2003). Hair et al (2010) argue that all variables used in a model have some degree of measurement error and a study should ensure validity and reliability when gathering such data so as to reduce these errors. Arguing that it is important to use those variables with higher reliability, they define validity as the degree to

[7] Gini index measures the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution. A Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality.

which a measure accurately represents what it is supposed to. Reliability is defined as the degree to which the observed variable measures the true value and is error free. In this study, data had to be readily attainable, reliable and consistent for it to qualify for inclusion in the SADC econometric model.

6.2.3.1 Dependant variable

Statistics on the historical passenger numbers between those major city-pairs that had air service connections between them could not be ascertained easily because the figures are not publicly available. There is however alternative sources of intra-SADC air transport statistics which allow estimates of the number of passengers carried between cities to be made. As highlighted in section 4.5.2.1 the major sources of this type of data were OAG, MIDT, SADC countries, airlines, AASA and AFRAA.

It is important to note that a general weakness that is common to many of these data sources, is that the passenger measure is of passenger traffic carried between cities A and B, regardless of whether the demand for travel was from A to C via B, or indeed, from X to B via A (Derudder and Witlox, 2005). Thus the data collected does not reflect the true origin and destination for such traffic. Instead the data collected splits such flights into two separate origin and destination trips. For example, as there is no direct air service between Kinshasa and Lilongwe, demand must be satisfied by passengers travelling from the DRC to Malawi via Johannesburg (or other connecting points) and this is recorded on two city-pairs. Their flight will be captured on both the Kinshasa – Johannesburg and on the Johannesburg-Lilongwe routes. This results in reinforcing perceived passenger demand on services into airports where connecting flights are offered.

6.2.3.1.1 OAG database

The OAG is a statistical database that contains information on schedules and route capacity of all scheduled commercial airlines of the world. This was used to obtain estimates of traffic volume between city pairs on the intra-SADC network. One weakness of the data is that it is primarily capacity focused. It tells the number of seats and flights each day provided by airlines operating between, say, cities A and B. To estimate the number of passengers carried requires the conversion of capacity (seats) to passengers by applying a load factor. This study used the actual average annual load factors for African airlines that are contained in IATA annual reports to deflate the seat capacity between intra-SADC routes.

6.2.3.1.2 MIDT database

The MIDT database contains the true origin–destination data on a transport network as it gathers information on passenger bookings from the Global Distribution Systems. Many of the intra-SADC airlines' passenger reservations are managed through electronic platforms such as Galileo, Amadeus and Sabre. The only disadvantage with this database is the fact that those bookings made directly with an airline would not be included in the statistics. For the SADC region, with the exception of South Africa, the extent to which bookings are made directly with airlines is limited by technological and communication challenges. This made this data base most suitable for use in this research. Given the high cost of obtaining this data, figures for one year (2009) were sourced. These demand figures were used as the dependant variable in the calibration of the SADC model.

6.2.3.1.3 Member states' air transport statistical databases

All member states of SADC maintain some air transport statistical databases as they use them for strategic planning purposes. Airport authorities, where statistics are critical for the purposes of passenger and airline user charges, maintain records per airline, per flight and per origin. Although this database reflects the actual passengers carried, it was difficult to get access to all airport authorities.

6.2.3.1.4 Airlines; AASA and AFRAA statistical databases

All airlines maintain data on their routes and have traffic forecasting units within their structures. Data from airlines is difficult to access as it is considered strategic and sensitive information. At the time this study was carried out, AASA and AFRAA did not have SADC airline industry statistics.

6.2.3.2 Explanatory variables

6.2.3.2.1 Airport passengers statistics

Data for passengers at airport terminals are obtainable from various sources; the ACI, ICAO and member states[8]. ACI is an international association of the world's airports and it publishes annual traffic data for its members. The database holds statistics on the total number of passengers (domestic and international) arriving and departing at an airport. One control the database has is that passengers arriving or departing on a flight bearing the same flight number are counted once.

The ICAO provides online air transport industry statistical data which includes airport annual traffic for its member states. The database which holds the same statistics as those held by ACI does not have information for all the airports. Civil aviation authorities, airports in SADC member states also maintain data on passenger statistics at various airports. Negotiating access to data from various government agencies was difficult. The study made use of the ACI database as it met the requirements of the study. For those airports that are not members of ACI, data was obtained from the ICAO. This was the case for data on Maseru airport in Lesotho.

6.2.3.2.2 Data on GNI per capita

There are various sources for data on GNI for SADC countries. The sources are central statistical authorities in each member state, regional statistical agencies,

[8] Ministries of transport, civil aviation authorities and airport organisations

the International Monetary Fund and the World Bank. This study considered the World Bank Development Indicators, an up to date database that is available online, as the appropriate source for data for the income variable.

6.2.3.2.3 Trade data

Data on trade is available from various sources. The major sources are the International Monetary Fund's Direction of Trade Statistics (DOTS), World Integrated Trade Solution (WITS)[9], The United Nations Commodity Trade Statistics Database (UN Comtrade), SADC trade database, member states[10] and regional trade organisations. These databases except the UN Comtrade, whose focus is commodities, include both trade in merchandise and services. This research considered the International Monetary Fund (DOTS) as the source that best met the requirements for uniformity and consistency.

6.2.3.2.4 Tourism data

UNTWO and SADC member states are a good source of origin-destination data as they provide an indication of tourism flows by origin. This facilitates the computation of inter-country tourism flows. The major weakness however lies with the definition of tourism as in many cases it is overnight visitors only that are recorded. The omission of same day visitors, a travel profile typical of airlines' business passengers, introduces a measurement error in the variable. To ensure consistency, data for this variable was sourced from the UNTWO database.

6.2.3.2.5 Data on shared borders and language

Data on shared borders and language and was obtained from member states and SADC websites.

6.2.3.2.6 Data on distance

[9] A database developed by the World Bank and the United Nations United Nations Conference on Trade and Development (UNCTAD).
[10] Central statistical offices, trade organisations

Data for distance was obtained from OAG. For those routes with no air service connections, data was calculated using the Great Circle Mapper (copyright © Karl L. Swartz).

6.2.3.2.7 Data on travel restrictions

Data for travel restrictions are available from the Regional Tourism Organization of Southern Africa (RETOSA) and government agencies responsible for immigration and tourism. Government agencies tend to have more accurate data as they are regularly updated. Travel restrictions data was therefore sourced from national governments' websites.

6.2.3.2.8 Data on human development levels

There is only one source that holds data on this variable. This is the UNDP database which is available online. Data was therefore obtained from this source. The study considered this database to be a reliable source as it makes use of both the IMF and World Bank statistics.

6.2.3.2.9 Data on political stability

Data on political stability indices can be sourced from Economist intelligence, the World Bank's World Governance Indicators, and various consultancy organisations. The World Bank database as it is available online and covers all countries that the study was looking at, was considered the most appropriate source.

6.2.3.2.10 Measurement of the explanatory variables

Gravity models assume the relationship between the variable to be predicted and the explanatory variables is multiplicative (the effects of each of the variables on traffic tend to multiply rather add up). The quantitative variables of the model, with the exception of trade and distance, are a product of the origin and destination interactions. Distance was squared to represent the impedance effect it has on intercity interaction. Trade was not considered multiplicative because the exports of one country are the imports of another country. To avoid double counting, the total trade was assumed to be imports plus exports. In

many cases there are variations in both exports and import figures because of timing differences between countries in recording of trade transactions. The higher figure in each case was used.

The distance used in this study is the great circle distance (as the crow flies). Kanafani (1983) argues that this variable has two conflicting effects. Increasing distance leads to lower social and commercial interactions. But longer distances on the other hand increase the competitiveness of air transport compared to other transport modes. Although it is possible that short haul trips (those below one thousand kilometres) are likely to face stiff competition from surface transport, the model did not adjust the distance variable because data on the nature of competition from surface transport was not available. Given the underdevelopment of surface transport, the study did not consider competition from surface transport to be important for inclusion in the model.

6.2.4 Model formulation

Airline demand is usually expressed by a demand function (Janic, 2007). This function inter-relates the volume of demand during a given period of time (day, week, month, and year) and the main demand driving forces. Since gravity models assume a multiplicative relationship between volume of passenger traffic (y) and the explanatory variables, these parameters are introduced into the model in a multiplicative manner. The demand function for the number of weekly air transport passengers between a given origin i and destination j on the intra-SADC is given by the following gravity model equation

$$\mathrm{V_{ij}} = \mathrm{a_0} \frac{POP_{ij}^{b_1} GNI_{ij}^{b_2} T_{ij}^{b_3} O_{ij}^{b_n}}{D_{ij}^{2^{b_4}} O_{ij}^{b_n}} \qquad \textbf{Equation 6-1}$$

Where:

V_{ij} is the volume of traffic between origin (i) and destination (j)

POP_{ij} is the product of population of the air traffic origin (i) and destination (j), respectively (in millions)

GNI_{ij} is the product of GNI per capita of the air traffic origin (i) and destination (j), respectively ($US)

T_{ij} is the interaction between origin (i) and destination (j) in terms of the value of trade, services and investments (million $US)

D_{ij}^2 is the squared distance between origin (i) and destination (j)

O_{ij} is the symbol embracing other variables that might influence the demand for air travel between origin and destination (this also includes dummy variables)

a_0 **is a constant**

$b_1, b_2 .... b_n$ are the regression coefficients of the demand function

6.2.5 Model estimation

This stage entails fitting the model to a set of data and using statistical measures to assess its goodness of fit and usefulness in predicting the dependent variable. Among a number of different approaches to estimation of the parameters of models, this study considered multiple regression analysis as the most appropriate. Described by Greene (2008) as the benchmark approach, the technique is designed to accommodate multiple variables. The advantage of multiple regression analysis is its ability to identify the independent effect of a set of explanatory variables on a dependent variable. It can also be used to predict the amount or size of the variable of interest (Hair et al, 2010).

Underlying the standard linear regression model is a number of assumptions than any model should meet. Greene (2008) lists six assumptions of the classical linear regression model:-

a) Linearity. The regression model specifies a linear relationship. In the regression context this linearity assumption refers to the manner in which the parameters and the disturbance enter the regression equation and not necessarily the relationship of the variables. Thus the model

expresses the concept that models possess properties of additivity and homogeneity.

b) Full rank. The regression analysis assumes orthogonal (not linearly correlated) explanatory variables.
c) Exogeneity of the explanatory variables. The disturbance is assumed to have conditional expected value zero at every observation
d) Homoscedasticity and nonautocorrelation. The variance of error terms are assumed constant over a range of explanatory variables.
e) Exogenously generated data. The data generation for the explanatory variables operates independently of the process that generates the disturbance e_i
f) Normal distribution. Regression assumes that the disturbances are normally distributed, with zero mean and constant variance.

In practice many models do violate some of these regression assumptions and corrective action has to be taken to remedy the breach. The way the study dealt with these issues is addressed in the proceeding sections.

6.2.5.1 Estimating gravity model equations

The multiplicative functional form of gravity models violates the linearity assumption. To rectify the breach and make the relationship between the dependent and the explanatory variables linear, the model is transformed using natural logs. In this form, what is multiplied (the generative variables) in the gravity model becomes added and what is divided (impedance variables) is subtracted. Equation 6-1 was therefore estimated in the following form:

$$\ln V_{ij} = a_0 + b_1 \ln POP_{ij} + b_2 \ln GNI_{ij} + b_4 \ln T_{ij} - b_3 \ln D_{ij} + b_n \ln O_{ij} + e_i$$ **Equation 6-2**

Where the explanation for the variables is the same as in equation 6-1 and

e_i in this equation is the random error term in the model

Once the assumptions of the regression analysis are satisfied, the unknown parameters of the log-transformed model are estimated. Using the ordinary least squares method, regression analysis generates an equation that describes the statistical relationship between one or more explanatory variables and the dependant variable. In conducting the regression analysis, measures of predictive accuracy are set and statistical tests are used to assess the significance of the predictive power. The objective is that the econometric model achieves acceptable levels of predictive accuracy to justify its application.

6.2.5.2 Assessing goodness of model fit

Regression results indicate the direction, size, and statistical significance of the relationship between explanatory variables and the dependent variable. Having fitted the regression equation to the model data the next step is to establish how sound, statistically, the econometric model is. Fleming and Nellis (2000) suggest four areas:-

a. Interpretation of the individual regression coefficients
b. Statistical significance of the regression coefficients
c. Overall predictive power of the estimated equation
d. Statistical significance of the overall predictive power

6.2.5.2.1 Interpretation of the individual regression coefficients

Regression coefficients represent the mean change in the response for one unit of change in the predictor while holding other predictors in the model constant. The sign of each coefficient indicates the direction of the relationship. The signs, magnitude and statistical significance of each of the regression coefficients are examined to ascertain their collective prediction of the dependent variable and their individual contribution to the regression model and its predictive power.

A priori assumptions on the SADC model are that regression coefficients for the population, per capita income, trade, tourism, border and language should be positive as they are postulated to be positively related to volume of air

passenger traffic. The regression coefficients of distance and travel restrictions are expected to be negative as the two variables are hypothesised to be inversely related to demand for air travel. The HDI and PSI are expected to be either negative or positive.

Since the SADC gravity model is multiplicative in nature the measured changes are in percentage terms. Each regression coefficient in the SADC model estimates the percentage change in the mean response per unit in the explanatory variable when all other explanatory variables are held constant.

6.2.5.2.2 Statistical significance of the individual regression coefficients

The size of each regression coefficient indicates the contribution the variable has to the variation in volume of city-pair passenger traffic that is associated with a unit change in overall predictive power of the model. The statistical significance of the individual regression coefficients is tested using a t-statistic test. In the regression equation, this involves testing whether the values of the regression coefficients differ significantly from zero at predefined level of significance (probability value). The null hypothesis for the t-test is $\boldsymbol{H}_0$: $\mathrm{b}_1 = 0$ and the alternative is $\boldsymbol{H}_1$: $\mathrm{b}_1 \neq 0$. This means that if the probability value (p-value) associated with a test of a regression coefficient is less than the chosen alpha (α)-level of significance which in the SADC model is 0.05, the relationship between the explanatory variable and the dependent is considered statistically significant.

6.2.5.2.3 Overall predictive power of the econometric model

The coefficient of determination R–squared ($\boldsymbol{R}^2$) measures the proportion of the total variation in the dependant variable (y) that is accounted for by the variation in the explanatory variables (Greene, 2008). This measure ranges from 0 to 100% and the more variation that is accounted for by the regression model, the better the model fits the data (Hair et al, 2010). $\boldsymbol{R}^2$ therefore provides an indication of the overall predictive power of the estimated regression equation (Mendenhall and Sincich, 2010; Greene, 2008). Hair et al (2010) suggests that

projects should aim at designing models that target to achieve higher predictive power. Their rule of thumb is 80%.

However R^2 has some problems in analysing a model's goodness of fit. Greene (2008) notes that R^2 will never decrease when more variables are added in a model. A higher R^2 would therefore not necessarily imply a better model. Computing the $R^2_{adjusted}$ is useful as it incorporates a penalty for the number of degrees of freedom used up in estimating parameters. Greene (2008) notes that $R^2_{adjusted}$ may rise or fall when a new variable is added in a model. Its movement depends on the contribution of the new variable to the fit of the regression model. $R^2_{adjusted}$ will increase only if the new explanatory variable improves the model. It also decreases when a new explanatory variable does not add value to the predictive power of the whole model.

Hair et al (2010) note that the $R^2_{adjusted}$ is a useful tool for comparing the explanatory power of competing models with the same dependent variable but different numbers of explanatory variables.

6.2.5.2.4 Statistical significance of the overall predictive power of the model

The statistical significance of the overall explanatory power as given by R^2 is assessed by the F test. Hair et al (2010) define the F-statistic as the ratio of the explained to the unexplained variance. They argue that the F-test compares the explanatory power of the full model to the reduced model with only the y-intercept term in it, which is equivalent to the sample mean. Thus, it compares a model with one or more partial slope coefficients to the sample mean model, to see if it provides a convincingly better fit to the data. This is therefore a test of whether or not the regression coefficients are equal to zero. As is the case with the t-test for the partial regression coefficients there is a null and alternate hypothesis stated as follows:-

H_0: $b_1 = b_2 = b_3 = b_n = 0$

H_1: $b_1 = b_2 = b_3 = b_n \neq 0$

If one rejects the H_0 the conclusion is that there is a significant relationship between the volumes of air passenger traffic and at least one of the explanatory variables and that the regression as a whole is significant.

6.2.6 Model final form

In regression analysis, many model formulations are attempted to achieve better levels of overall predictive power. The statistical measures stated above are used to refine the model, and to compare and contrast various “good” model formulations. Once the process of iteration between different models is completed, the model that is considered to be capable of producing the best results is checked to ascertain whether it meets the original regression assumptions. Of the several violations that are known to arise in practice five were considered vital for this study. These are;

a. Non-linearity of the regression function
b. Heteroscedasticity of the error terms
c. Extreme influence by outlying observations
d. Non-normality of error terms
e. Multicollinearity of independent variables

6.2.6.1 Non-linearity of the regression function

Although non-linearity in the SADC model was removed by the transformation of the model into natural logs, the original assumptions are still checked to ensure the model produces good results. The statistical software packages that this study used offer various diagnostic plots by which the linearity of the equation of a model was checked.

6.2.6.2 Heteroscedasticity of the error terms

Kaemmerle (1990) defines heteroscedasticity as a condition in which the assumption that the variance of each error term is constant is not met. Heteroscedasticity according to Greene (2008) usually arises in cross-sectional data where the scale of the dependant variable and the explanatory power of

the model tend to vary across observations. This is the case in the SADC model, where the observed volume of weekly passenger air traffic on intra-SADC city-pairs ranges between 87 and 4,380. Where the range in the value of the dependent variable is large, the variances of the larger values are more likely to be greater (Kaemmerle, 1990). Although the log-linear transformation of the SADC model helped reduce the possibility of heteroscedasticity by compressing the scale by which the variables were measured; the study relied on diagnostic plots in a bid to detect any non-constant errors.

6.2.6.3 The presence of unusual observations (i.e. outliers)

Greene (2008) defines outliers as observations that exert extreme influence on the fit of the estimated regression function. They indicate the possibility of errors or unusual events. The use of plots of standardized residuals and statistical techniques helped in the detection and investigation of outliers. The general rule of thumb suggested by regression analysis literature in dealing with outliers is to leave them in the model unless one can prove there was an error in recording or the data points are unique in some identifiable way and deserve their own model. As regulatory restrictions still constrain demand on certain routes in SADC, the inclusion of outliers was considered adequate representation of the phenomenon under study.

6.2.6.4 Non-normality of error terms

Arguing that moderate departures from error-term normality are not known to create serious problems for models, Green (2008) suggests that serious departures from normality are of concern. This is because when the errors are not normally distributed, one cannot make inferences based on the regression function. The use of a transformed model facilitated the remedying of non-normality of the residuals of the model. Various techniques such as boxplots and histograms were however used to assess whether the model had any normality of distribution of error terms.

6.2.6.5 Multicollinearity of explanatory variables

Multicollinearity arises when explanatory variables are correlated to other explanatory variables. Explanatory variables are often correlated when, as is the case for the intra-SADC network, observational data are collected (Greene, 2008). Whilst moderate multicollinearity may not be problematic, severe multicollinearity may have the negative effect of increasing the variance of regression coefficients, making them unstable and difficult to interpret. Two methods by which multicollinearity in a model can be detected is by reviewing the variance inflation factor (VIF) and the examination of the correlation structure of the explanatory variables. The VIF (available in MINITAB software) measures how much the variance of the estimated regression coefficient are inflated as compared to a situation where the variables are not linearly related. The statistical software this study relied on, MINITAB, suggests the following guidelines in interpreting VIF:-

VIF = 1	Absence of multicollinearity
VIF $>$ 1 $<$ 5	Moderate correlation
VIF>5<10	Highly correlated

The general rule of thumb in multiple regression analysis is that, correlation higher than 0.7 or VIF higher than 5 should be investigated. Greene (2008) suggests that highly correlated explanatory variables may have to be excluded.

6.2.7 Model validation

A model is only useful as an estimation tool when one is convinced of the reliability of the relations the model purports to have established. Checking model adequacy helps a study in determining whether the regression model fits the sample data. However models that fit sample data well may not be successful predictors of the dependent variable when applied to new data (Mendenhall and Sincich, 2003). It is for this reason that before a model is considered its validity is subjected to diagnostic analysis. Mendenhall and

Sincich (2003) point out that the reason models are validated is to assess how the fitted regression model will perform in practice (i.e. how it will perform when applied to new or future data). One method for validating the model is to compute the $R^2_{predicted}$ from the same data or to apply the model on a new set of data. Both approaches were adopted in checking whether the SADC model could reproduce a known state of the intra-SADC air transport system with sufficient accuracy.

6.2.8 Model implementation

Once a validated model is deemed to be useful for the purpose it was designed to achieve, it is applied to estimate or predict the dependant variable. The SADC model was therefore applied to data on the city-pairs that had no air service connections establish whether there was adequate demand to justify direct air service connections.

6.3 SADC gravity model estimation and results

The data used for fitting the SADC gravity model is presented in Appendix D. With 32 observations at the disposal of this study, the intention was to develop a model that best describes the hypothesised relationship between air travel demand and explanatory variables with as few variables as practicable. Although smaller and larger models can be found in studies that have used gravity models, literature on econometric analysis suggests a minimum of 5 to 1 ratio where each variable has at least five observations (Greene, 2008, Hair et al, 2010). Whilst the study identified ten potential explanatory variables, the maximum number that the study could permit in the final model was five.

Arguing against the indiscriminate insertion of variables into a regression model, Hair et al (2010) and Greene (2010) suggest a number of systematic methods that are designed to reduce a large list of potential explanatory variables to more manageable levels. The most widely used methods are stepwise regression and the all-possible-regressions-selection procedure. The advantage of these two techniques is that they objectively determine the independent

variables that are the most important predictors of the dependant variable and those that are least important. This study applied both methods to come up with two competing model formulations. The intention was to identify the model with the best predictive power.

6.3.1 Model A and B formulations

The ten potential explanatory variables the study identified as possible predictors of the volume of air passenger traffic on SADC city-pairs were inserted into the gravity model using both the stepwise regression and all-possible-regression selection procedure. For each variable screening method, the best regression fit was selected on the basis of the following:-

- The highest predictive power i.e. the highest $\boldsymbol{R}^2$ and $\boldsymbol{R}^2_{\text{adjusted}}$.
- Regression coefficients of explanatory variables significant at $\alpha = 0.05$
- The highest significance the overall predictive power of model as measured by the F-statistic

Three explanatory variables population, distance and trade met the requirement of an alpha level of significance that was set at 0.05 per cent to qualify for entry into the stepwise regression model. The regression model with the highest predictive power under the all- possible- regression selection had five explanatory variables. These are population, distance, trade, PSI and shared language. The regression outputs from MINITAB are presented in Appendix E with the stepwise regression labelled as model A and the best-subset-regression labelled model B.

6.3.2 Model A and B estimation

The two regression models arising from the two variable screening methods were re-estimated for further analysis. The regression outputs from the estimation of the regression models are presented in Appendix F.

Each model was assessed for goodness of fit and whether they achieved acceptable levels on statistical criteria. Both models achieved high levels of

predictive power as they accounted for more than 80 per cent variation in the percentage changes in variation in the number of weekly passengers on intra-SADC network. All the regression coefficients had the correct signs and were significant at the 0.05 significant levels.

However, whilst model B had the highest R^2 and $R^2_{adjusted}$, the overall significance as measured by the F-test was lower than that of model A. The study therefore considered model A the better model for use in estimating the passenger volumes on SADC city-pairs. The regression equation for the preferred model is

lnPass Traffic	**= 2.16**	**+ 0.562 lnPOP**	**- 0.308 lnDistance**	**+ 0.182 lnTrade**
t	**= 2.42**	**5.55**	**-3.06**	**2.84**
p-value	**= 0.022**	**0.000**	**0.005**	**0.008**
		R^2 = 81.2 %	**$R^2_{adjusted}$ = 79.2%**	**F = 40.38 p = 0.000**

Equation 6-3

6.3.2.1 Interpretation of results for model A

6.3.2.1.1 Overall significance

Global F = 40.38 (p-value = 0.000). At any significance level α >.0001, the null hypothesis H_0: $a_1 = a_2 = a_3 = 0$ is rejected. Thus there is sufficient evidence to indicate that the gravity model is statistically useful for estimating weekly passenger numbers on the major-city-pairs in SADC.

$R^2_{adjusted}$ = 79.2 %. After accounting for sample size and regression parameters in the model, approximately 79 per cent of the sample variation in O/D passenger volumes on SADC city-pairs is explained by a model with population, distance and trade.

s = 11.9947. Approximately 95% of the observed log-transformed dependent variable lies within 2s of their predicted value.

6.3.2.1.2 Regression coefficients

Based on the t–statistic in equation 6-3, the explanatory variable lnPOP (passengers at airports) has the highest contribution of 5.5 to the predictive power of the model. The lnDistance explanatory variable (the squared distance between SADC city-pairs) at -3.06 is the second highest contributor to the predictive power of the model. The contribution of the third variable lnTrade (inter-country trade on the city-pair served) is also significant to the predictive power of the model. The parameters of the regression coefficients model are all highly significant (p-value < 0.01). The conclusion is that the gravity model is adequate for estimating demand on those city pairs with no air service connections.

6.3.2.1.3 Residual analysis of the model

Diagnostic analysis carried out to detect any violation of the original regression assumptions of linearity, independence, equal variances and normal distribution did not show any evidence of such breach. The study made use of a histogram and a normal probability plot for the standardised residuals. The usefulness of a histogram is that is shows the general characteristics of the residuals including typical values, spread, and shape. The normal probability plot on the other hand helps in detection of any violation of the normal distribution assumption. Ideally the points in this plot should generally form a straight line if the residuals are normally distributed. If the points on the plot depart from a straight line, the normality assumption may be invalid.

Both graphs for the SADC model are presented by Figure 6-2 and 6-3 respectively. The graphs support the regression assumption of normally distributed errors.

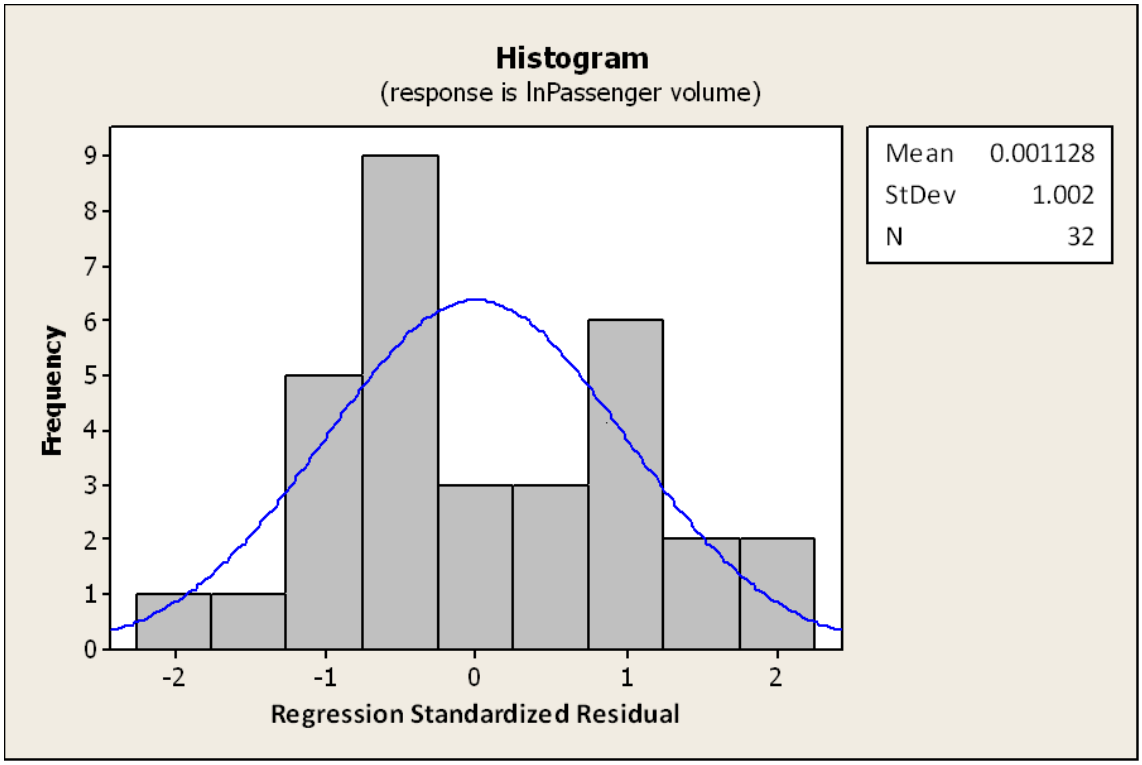


Figure 6-2 Histogram for SADC gravity model

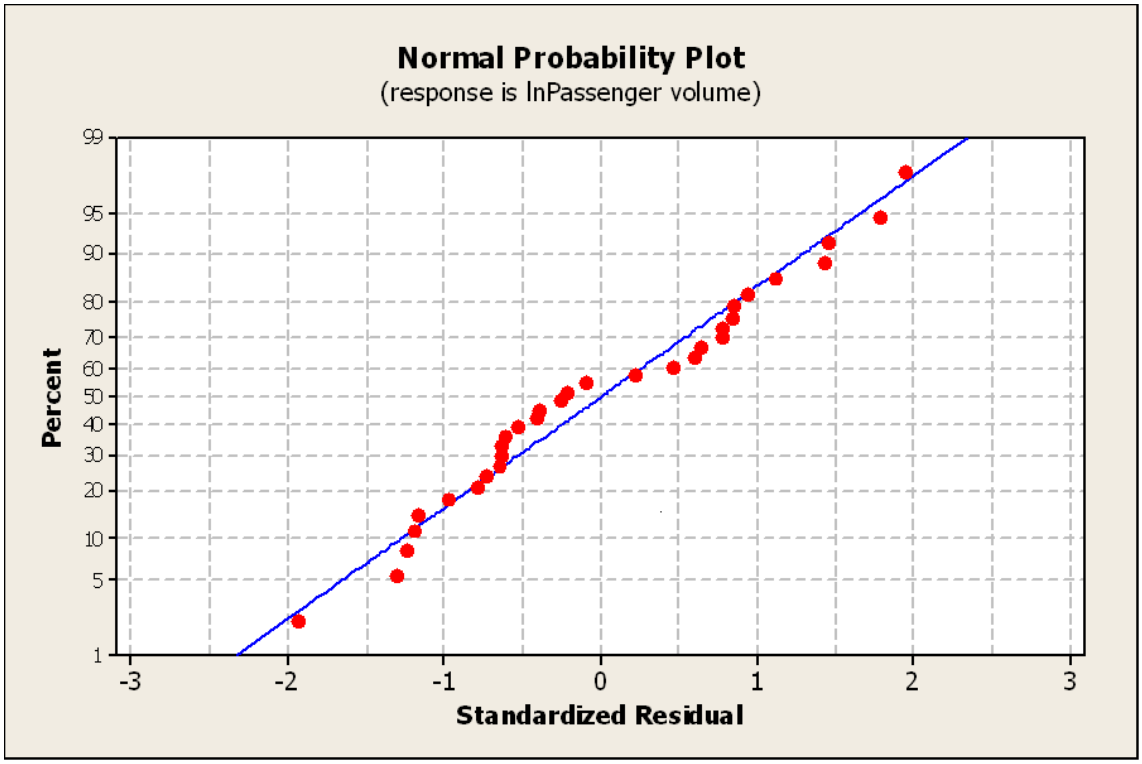


Figure 6-3 Normal probability plot for SADC gravity model

The study plotted both standardised and standardised residuals versus the predicted passenger volumes. Ideally these plots should show a random pattern of residuals on both sides of 0 and there should not be any recognizable patterns in the residual plot. Other than a few outliers like Harare-Maputo and Antananarivo-Mauritius, the plots exhibit no distinctive patterns. One of the plots is presented in Figure 6-4.

The results from the diagnostic analysis suggested that the model could be validated for use with no further adjustments.

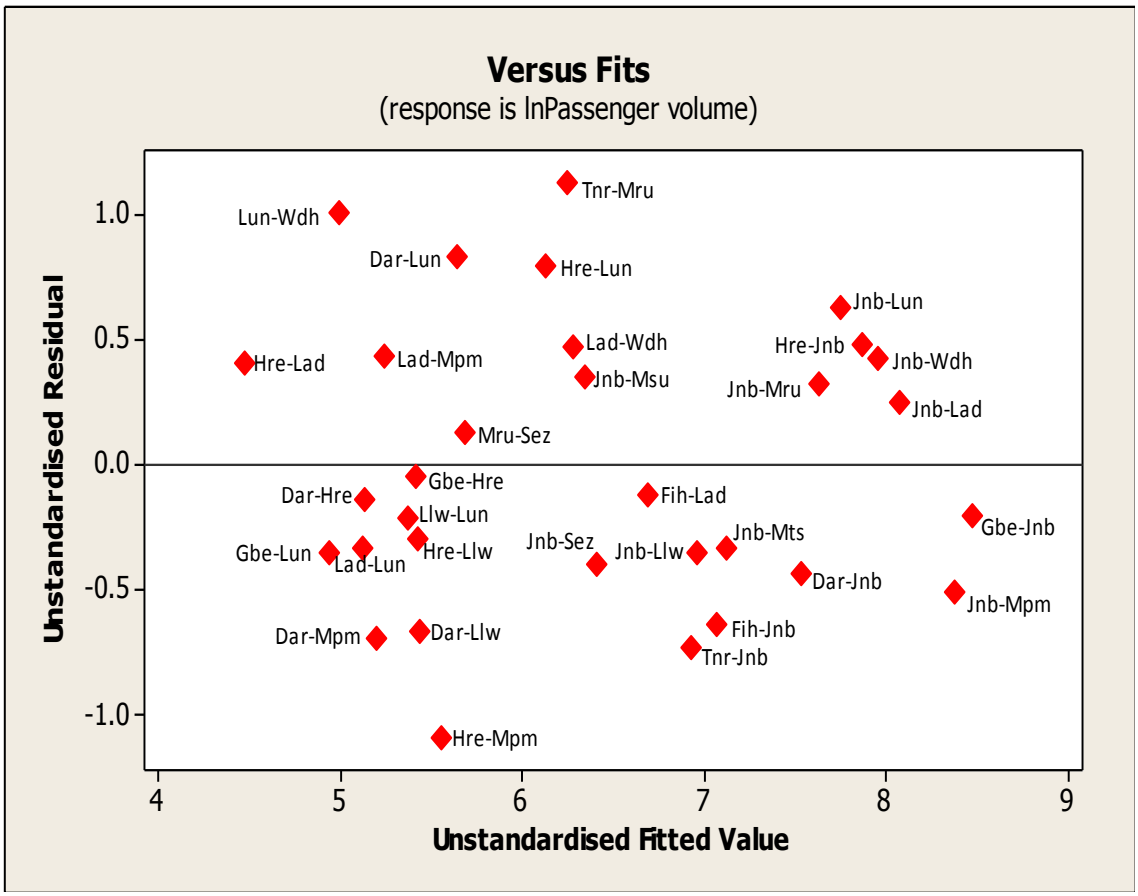


Figure 6-4 Plot of unstandardized residuals for the SADC gravity model

6.3.2.1.4 Detection of multicollinearity

The study examined both the variance inflation factors and the correlation structure of the explanatory variables of the model. The final model's VIFs, computed with the aid of MINITAB and contained in Appendix F fall within

moderate correlation and did not require any investigation. Furthermore a correlation matrix that is presented in Table 6-1 was constructed with the aid of Microsoft Excel.

Table 6-1 Correlation matrix for final model

	lnPass Traffic	lnPOP	lnDistance	lnTrade
lnPass Traffic	1			
lnPOP	73%	1		
lnDistance	-14%	41%	1	
lnTrade	78%	51%	-25%	1

The matrix does not reflect any incidence of highly correlated explanatory variables.

6.3.3 SADC model validation

Of the various model validation techniques that literature on model validation suggests, the study made use of four. The techniques applied in this study were the:

a) Computation of the predicted R^2
b) Examination of the predicted values of the fitted model
c) Examination of the estimated model parameters
d) Collection of new data for prediction

6.3.3.1 Computation of the predicted R^2

Predicted R^2 is used in regression analysis to indicate how well a model predicts responses for new observations. Predicted R^2 ranges between 0 and 100 percent and larger values suggest models of greater predictive ability. The usefulness of predicted R^2 lies in its ability to prevent over-fitting the model. Over fitting refers to models that appear to explain the relationship between the dependant and independent variables for the data set used for model calibration but fail to provide valid predictions for new observations.

With a computed $R^2_{predicted}$ of 79.6 per cent in comparison to an R^2 adjusted of 79.2 percent, the results indicate a properly fitted model and suggest that the SADC model would predict new observations nearly as well as it fits the existing data.

6.3.3.2 Examination of predicted values

Mendenhall (2003) posits that the predicted values of a fitted regression model can help identify an invalid model. By directly comparing the predicted values to the observed values of the model, one can determine the accuracy of the predictions and use this information to assess how well the model performs in practice. To assess the extent to which the predicted demand figures from the SADC model agreed with the actual passenger demand obtained from MIDT database, a scatter plot was constructed with the aid of MINITAB software. A visual inspection of the scatter diagram, presented in Figure 6-5, reflects no observable trend or uniqueness in the dispersion of city-pair points lying above and below the line of best fit.

The scatter points lying above the regression line represent city-pairs where the gravity model predicted values that were lower than the actual observed demand. This is observable on such city-pairs as:

- Harare-Johannesburg
- Johannesburg- Lusaka
- Johannesburg- Luanda
- Johannesburg-Windhoek

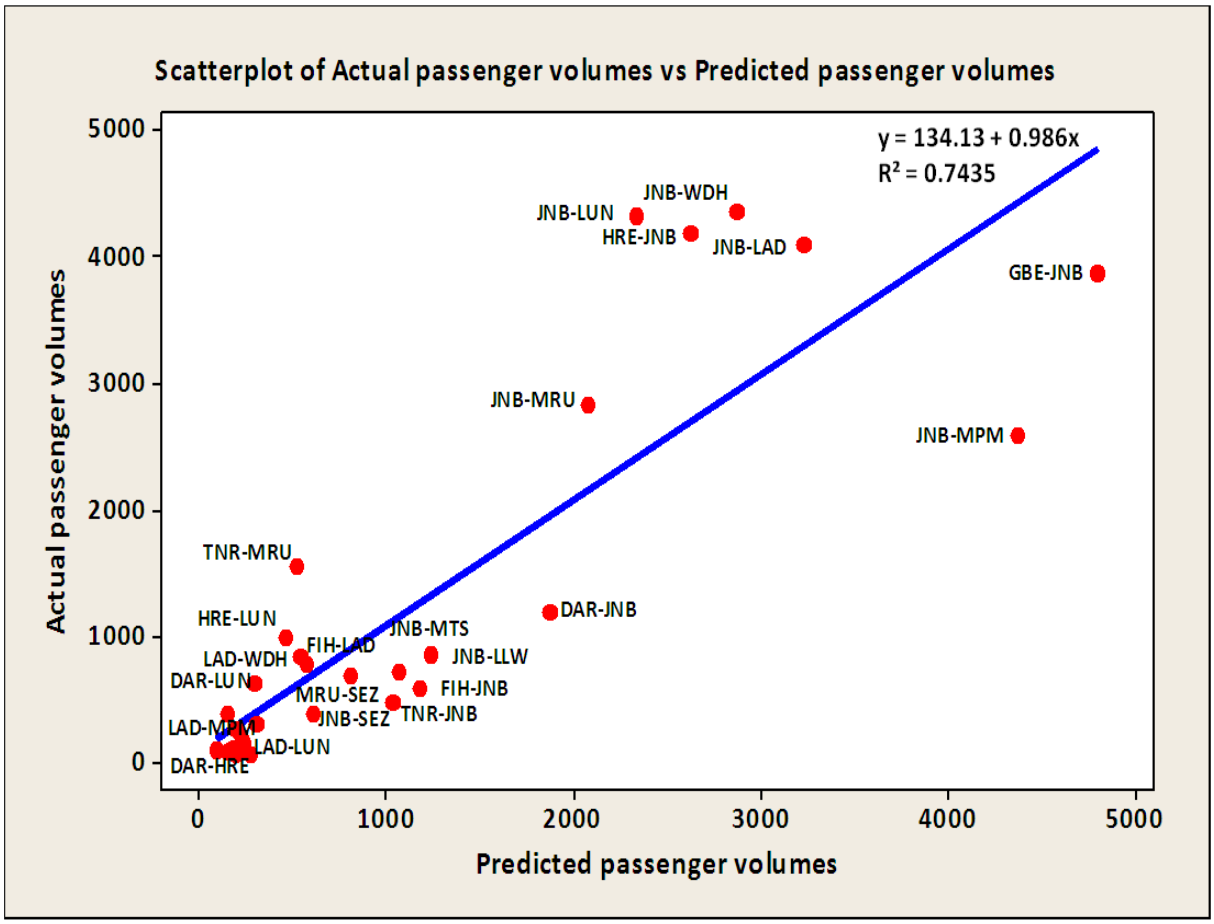


Figure 6-5 Scatter plot for actual passenger volumes versus gravity model predictions

Scatter points lying below the line of best–fit represent city-pair connections where the gravity model's predictions over-estimated passenger volumes when compared to actual observed data. Some of the city-pairs where this phenomenon is observed are:-

- Antananarivo- Johannesburg
- Dar es Salaam-Johannesburg
- Gaborone-Johannesburg
- Johannesburg-Maputo

An in-depth analysis reveals that 44 percent under-estimate and 56 percent over-estimate actual demand figures. In addition city-pair connections involving Dar es Salaam, Gaborone and Lilongwe generally tend to overstate actual demand whilst those involving Harare, Windhoek, Mauritius and Luanda have

lower estimates than observed demand. The study acknowledges the fact that this could be attributable to the fact that certain variables that are unique to SADC such as fares (at route level) and supply-side dynamics in terms of the extent of deregulation and aircraft technology were not included in the model.

This is further explained by the data sets' correlation coefficient of determination (R^2) of 0.7435. With 74 percent of the variation between the predicted and actual passenger numbers accounted for by the correlation between these two data sets, the 26 percent unaccounted for, suggests more variables could have been added to improve the prediction ability of the SADC model.

This study however considered the correlation coefficient of determination of 74 percent to be adequate enough a proof of a strong closeness between the gravity model's predictions and the observed actual demand. The conclusion was that the SADC model was adequate for use in predicting demand on intra-SADC city-pairs.

6.3.3.3 Examination of estimated model parameters

Mendenhall (2003) argues that the relative size and sign of model parameters can be used as a check on the estimated β coefficients. Coefficients with signs opposite to what is expected may indicate that the final model may perform poorly when applied to new or different data. The study expected the β coefficients associated with population and trade to be positive and a negative relationship between distance and demand for air travel. The regression coefficients of the SADC model met the all the a priori assumptions.

6.3.3.4 Collection of new data for prediction

Using a developed model to predict weekly passenger numbers for a new sample is considered one of the most effective ways of validating a model. Mendenhall (2003) suggest that the number of observations in the new data set should be large enough to reliably assess the model's prediction performance. Literature on model validation recommends 15-20 new observations at minimum.

An independent set of demand data; the daily seat capacity obtained from the OAG and adjusted to reflect load factors in 2009 was used to check whether this model would replicate the travel pattern reflected by the data. A sample of major city- pairs with direct flight connections between them in 2009 was chosen. To reduce subjectivity in arriving at passenger demand figures, only non-stop direct connections were considered for inclusion in the sample. It is for this reason that one-stop connections of Maputo-Pemba-Dar es Salaam, Luanda-Harare and Luanda-Lusaka were overlooked. As already mention in 6.2.3.1.1 capacity data was converted to passengers by applying load factors contained in IATA annual reports. The actual average load factor the study applied to deflate seat capacity on intra-SADC flights for the year 2009 was 0.699. The study identified 25 city-pairs for model validation.

With the aid of a statistical software package, MINITAB, the study computed the percentage of variability in the new data explained by the model's $R^2_{predicted}$ and compared it to the coefficient of determination (R^2) for the least square fit of the final gravity model. The $R^2_{predicted}$ computed for the new data set, at 80.7 percent, compares favourably to R^2 of 81.2 percent for the least square fit of the final gravity model. The study was therefore confident that the SADC model was useful for prediction in practice.

The data and results used in the validation of the model are contained in Appendix G

6.3.4 Estimates of weekly passenger traffic on intra-SADC city-pairs

The SADC model was used to estimate potential passenger numbers between those city-pairs that had no direct flight connections. The results are presented in Figure 6-6. The model's predicted weekly passenger volumes reflect that many city-pairs in SADC are characterised by thin demand. There is however evidence that there are a number of city-pair connections with sufficient traffic for airlines to mount profitable scheduled commercial operations.

To determine the city-pair that had adequate demand to justify direct and non-stop flights, the study converted the demand estimates on each city-pair to fit capacity on a 50 seat regional aircraft. The need to match capacity with the nature of demand on intra-SADC routes dictated the use of regional aircraft sizes in converting demand estimates. An assessment of the regional aircraft size available in the region indicates the 50 seat aircraft as the most commonly used. The study assumed a load factor of 60 per cent, based on IATA annual forecasts for Africa. This meant that a flight would require 30 passengers each way. The threshold for a city-pair to qualify for direct air service connection was 120 passengers a week which translated into two flight frequencies. The study identified 23 city-pair connections with potential to have direct air service connections.

	DAR	FIH	GBE	HRE	JNB	LAD	LLW	LUN	MPM	MRU	MSU	MTS	SEZ	TNR	WDH
Dar es Salaam (DAR)	-	217	102	204	2,082	269	250	318	253	310	6	78	74	191	123
Kinshasa (FIH)		-	86	193	2,744	100	55	310	75	39	3	6	13	62	21
Gaborone (GBE)			-	310	5,665	98	54	194	180	120	24	59	11	47	212
Harare (HRE)				-	3,402	64	274	583	304	187	13	58	68	66	127
Johannesburg (JNB)					-	4,085	1,157	2,966	4,817	2,310	521	1,190	650	1,183	3,223
Luanda (LAD)						-	24	177	137	217	7	12	25	31	570
Lilongwe (LLW)							-	249	190	89	15	58	22	32	13
Lusaka (LUN)								-	182	235	13	61	57	72	170
Maputo (MPM)									-	237	18	234	35	76	152
Mauritius (MRU)										-	36	13	313	605	103
Maseru (MSU)												3	3	21	6
Manzini (MTS)													5	44	9
Seychelles (SEZ)													-	137	22
Antananarivo (TNR)														-	20
Windhoek (WDH)															-

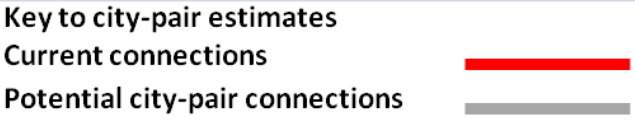


Figure 6-6 Weekly passenger estimates for the intra-SADC air transport network

The results also reveal that certain city-pairs estimates are higher than actual demand on some routes that are currently being served. Dar es Salaam-Mauritius, Kinshasa-Lusaka, and Harare-Maputo have passenger numbers above 300, a figure higher than current demand and estimates for Luanda-Maputo, Luanda-Lusaka and Luanda-Harare. Coincidentally these city-pair connections relate to countries whose airlines have been struggling to survive or have been liquidated. This suggests a situation where the opportunity is not being exploited because of the absence of service providers.

6.4 Conclusion

This chapter developed a gravity model to evaluate the pattern of air passenger demand on the intra-SADC air transport network. The study uses a gravity model, which although a broad brush measure provides useful indicators of demand dynamics in SADC. The SADC model was calibrated to fit cross-sectional data on 32 city-pairs that had air service connections in 2009 using regression analysis. The objective of using regression analysis was to estimate the unknown parameters of the model, use the data to study the validity of the theoretical propositions of the gravity model and use the model to predict the number of weekly passengers between the SADC city-pairs with no direct flights. Although low levels of passenger demand seem to characterise the majority of city-pairs in the region, the research identified nodes with sufficient demand to justify direct connections which would in turn reduce network fragmentation. The existence of demand even in an environment of regulatory restrictions suggests air transport liberalisation would stimulate more demand.

7 Chapter Seven: Factors accounting for liberalisation strategy failure

7.1 Introduction

This chapter summaries and interprets the data obtained from interviews held with various experts and officials. It also analyses documentary material from SADC's airline financial statements, minutes of the meetings held by ministers responsible for air transport in SADC as well as evaluating the available published literature.

In chapter 5, this study benchmarked network changes achieved by SADC to two developing regions, ASEAN and MERCOSUR, who are operating in similar socio-political environments and under a regime of limited air transport deregulation. Section 5.7.2 reveals that despite having a liberalisation strategy policy that covers multiple designations of airlines, liberal exchange of traffic rights (particularly fifth freedom), the removal of restrictions of foreign ownership in airlines and fair competition regulations, SADC's air transport liberalisation strategy execution lags behind those of ASEAN and MERCOSUR. In other words these four pillars, considered necessary and sufficient conditions for successful implementation of civil aviation do not exist in practice in SADC. Additionally, the econometric model that the study developed to evaluate demand patterns reveals in section 6.2.7, that despite seat capacity (supply) restrictions and very thin demand patterns that characterise the majority of city-pairs interactions in SADC, there are a number of capital city-pair routes with adequate demand to justify direct and nonstop air service connections. This is indicative of strategy implementation failure.

This chapter examines the factors underlying the failure by SADC to;

- Designate sufficient airlines,
- Allow liberal exchange of traffic rights,
- Encourage private sector participation and
- Encourage competition.

Gertz and Lee (2011) observe that one major reason for missing strategy goals is that leaders do not invest the same amount of time, energy, and resources in managing the implementation of the strategy as they do in setting the strategy. They propose three pillars of effective and efficient strategy execution. These are direction, structure and people. They argue that direction provides a road map of where to go, structure affords a holistic description for how work will be conducted and people constitute the resources for doing the work. The failure to address these conditions in implementing organisational strategy results in failure. This chapter examines each of SADC member states before evaluating how direction, structure and people issues affected strategy implementation.

7.2 Profile of SADC countries

The origins of SADC are found in the Southern African Development Coordinating Conference (SADCC), a loose coalition launched in 1980 by nine independent countries of Southern Africa. These are Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia, and Zimbabwe.

In August 1992 SADCC progressed into a legal entity, SADC as states recognized the need for social, economic and political regional integration. The creation of SADC was originally politically motivated as it was aimed at reducing economic dependence on apartheid South Africa and to help remaining colonised countries (Namibia and South Africa) achieve independence. The end of apartheid in 1994 and the accession of South Africa to SADC witnessed a significant shift in regional objectives towards the pursuit of regional economic growth and social development. SADC's ideal vision is that of "a common future in a regional community that will ensure economic well-being, improvement of the standards of living and quality of life." The evolution of SADC witnessed an increase in membership to the current 15 countries as of April 2011. The new additions were Namibia (1990), South Africa (1994), Mauritius (1995), the DRC (1997), Seychelles (1997) and Madagascar (2004).

7.2.1 Angola

Angola is recovering from three decades of civil conflict that ended in August 2002 and left the country's infrastructure and economy in bad shape. Ironically, air transport in some ways benefits from conflict. For many years the only secure way to travel between Angola's major cities was by air. Peace and stability has brought about phenomenal economic growth. The country's real GDP (constant 2000 US$) realised an increase from US$9 billion in 1998 to US$26 billion by 2010. GNI Purchasing Power Parity (PPP) also registered a rise from US$24 billion in 1998 to US$104 billion in 2010. The country's economic turnaround that is attributed to the oil sector has relatively improved living standards for its population. Business Monitor International (2009) reported that part of the oil revenues are financing infrastructure rehabilitation and development. The improvement in standards of living for Angolans has boosted leisure traffic into the region, meaning that Angola has become a generator of outbound tourism to the region. Given the peace prevailing in the country, Angola has been afforded the opportunity to host continental sporting events and conferences and this generates official and leisure traffic into the country from other SADC states, and from other parts of Africa and the world generally.

The improvements in the standards of living of Angolans are yet to be reflected in the airline industry. On the basis of the latest information on airlines registered in Angola as per the JP fleet database, there are a number of airlines registered in Angola. The period that this study reviewed did not witness any private sector participation on the regional scheduled commercial air transport market. An assessment of a sample of the BASAs that the country has negotiated with other SADC member states reflects TAAG Angola (DT), the national flag carrier as the only designated airline.

This state of affairs suggests that scheduled commercial air transport is still considered an infant industry. The reason being that at the onset of reforms Angola was embroiled in a protracted civil conflict that did not allow the state

and the airlines operating in the country to develop a fully commercial approach to scheduled regional air service provision leaving them ill-equipped to adjust to the 1998 liberalisation strategy.

7.2.2 Botswana

Botswana is deemed the most stable country in the region as it has never suffered any conflicts since independence in 1966. As a result it draws a significant number of international tourists to the region. Though landlocked, Botswana has transformed itself from one of the poorest nations of the world to a middle-income country. Although the mining of diamonds accounts for a third of the country's GDP, Botswana has also diversified its economy by focusing on tourism and the cattle industry. Over the period under review, Botswana's real GDP which at 1998 was US$8 billion grew by 60 per cent over the period ending 2010. GNI (PPP) which at 1998 was US$11 billion registered a 108 per cent growth for the same period. This change in fortunes is reflected in the steadily improved living standards of the Batswana, with businesses looking for investment opportunities in the neighbouring countries. Trade activities have in turn generated both inbound and outbound tourism flows particularly with neighbouring countries. Indeed, it is also noteworthy that SADC headquarters are located in Botswana.

As is the case with Angola, only one airline, Air Botswana the state owned flag carrier has featured on the intra-SADC network during the period under review. Although the route connecting Botswana with South Africa is considered to be one of the most liberalised in SADC (SADC, 2009), the benefit has generally accrued to South African carriers. Information listed on the Civil Aviation Board of Botswana's website reveals a number of privately owned airlines confined to charter operations (non-scheduled operations).

7.2.3 The DRC

Endowed with a large population, natural resources and substantial wealth potential, the DRC like Angola is also recovering from a long-drawn-out civil war

that destroyed the country's infrastructure and shattered the economy. On the basis of the latest World Bank economic indicators the DRC is reported to have posted inflation adjusted GDP of US7 billion in 2010, up from US$5 billion in 1998. However, the International Monetary Fund notes that much of the country's economic activity takes place in the informal sector making it impossible for the country's GNI figures to reflect the accurate economic growth position of that country. Simon and Johnston (1999) note that the country, because of its population and abundant natural resources, offers potential location for foreign direct investment in natural resource exploitation and food processing.

The DRC is one of the SADC member states in which liberalisation has seen the government moving out of airline businesses and leaving the private sector to provide air services on the intra-SADC network. One airline, Hewa Bora Airways (now Fly Congo) has served the regional network consistently. Another airline that served the intra-SADC network was Lignes Aeriennes Congolai (Congolese Airlines) but it only survived for three years before ceasing operations. The latest available statistics in the JP fleet database shows a number of carriers that have been registered to offer commercial air transport services. Schlumberger (2010) suggest that there were 9 airlines that were based in DRC as at 2007.

The country's air transport industry has faced challenges on oversight regarding safety and it has been dogged by aircraft accidents.

7.2.4 Lesotho

The Kingdom of Lesotho is a small mountainous country surrounded by South Africa. This country is therefore overshadowed by South Africa and its potential is tied to the regional economic giant. Although the country's inflation adjusted GDP has not changed over the period under review, the GNI (PPP) has posted a positive growth of 100 per cent from US$2 billion in 1998.

Lesotho is another SADC country whose state owned carrier ceased operations in February 1999 soon after the onset of reforms. A South African registered carrier South Africa Airlink (4Z) is the only airline on the route to South Africa.

7.2.5 Madagascar

Madagascar has witnessed a significant improvement to its economy as a result of IMF and World Bank initiated reforms. Whilst real GDP at 2010 registered a 25 per cent growth from US$4 billion in 1998, GNI (PPP) posted an 82 per cent increase over the same period. Madagascar's large population offers market expansion opportunities for firms within the regional economic bloc.

Air transport is the only mode of transport by which this country can interact with the continental partners and the other two island states in SADC. The JP fleet database reflects a number of airlines that authorities have given licenses to operate commercial flights. Schlumberger (2010) suggests there were two airlines in Madagascar in 2007. The only airline that has served the intra-SADC network is Air Madagascar (MD), the national flag carrier. The country has however suffered from political unrest. The potential trade and tourism contribution of the country to the regional economic grouping during the period under review has been overshadowed by civil conflict.

7.2.6 Malawi

Malawi is not only one of the poorest countries of the world but also a highly indebted poor country (HIPC). The country's economy is predominately agricultural and it has received support from the World Bank and the International Monetary Fund during the period under review. On the basis of the latest World Bank indicators the country's real GDP of US$3 billion represented a growth rate of 50 per cent over the period 1998 to 2010. GNI (PPP) over the same period witnessed a 117 per cent growth to US$13 billion.

Historically Malawi is known to have been the source of labour, (notably unskilled labour) for some of the countries of Southern Africa. This has

generated both inbound and outbound tourism flows as Malawian residents return home to visit friends and relatives mainly by road transport.

The country has only one airline registered for commercial air transport. The only airline that has served the intra-SADC is the wholly stated owned Air Malawi.

7.2.7 Mauritius

Mauritius has transformed itself from a low-income, predominantly agricultural economy to an upper middle-income diversified economy. Simon and Johnson (1999) suggest that SADC's motivation for accepting Mauritius' application for membership was essentially "to garner that country's experience in transforming a sugar-producing, tourist resort island into a dynamic liberalised, export-oriented economy." Based on the latest available World Bank statistics, Mauritius's real GDP grew from US$4 billion in 1998 to US$7 billion in 2011. GNI (PPP) over the same period grew by 125 per cent to US$18 billion. The SADC region has given Mauritius the opportunity to market its product on the mainland. Business relations with the mainland have in turn generated inbound tourism traffic to Mauritius.

There is conflicting evidence on whether Mauritius is bound by the provisions of the YD or not. Schlumberger (2010) contends they are but the African Aviation Commission (AFCAC, 2011) suggests otherwise. The country is however legally bound by the provisions of the SADC Protocol on TCM.

Although the Mauritian Government has retained only 44.42 per cent ownership in the national flag carrier, air transport has been dominated by Air Mauritius and it is the only airline that has featured on the intra-SADC network. Schlumberger (2010) suggest there were 2 carriers in Mauritius in 2007.

7.2.8 Mozambique

Mozambique suffered a devastating civil conflict for over two decades that ended in October 1992. Although there are signs of economic recovery, the

country is one of the poorest in the world and as is the case with Malawi, is also classified as an HIPC. Real GDP in Mozambique has grown from US$4 billion in 1998 to US$9 billion in 2010. GNI (PPP) has also posted a 214 per cent over the same period.

Mozambique, with the support of the World Bank, has embarked on major infrastructure rehabilitation. Many South African businesses have invested in Mozambique. The country also has substantial tourism potential. A recent SADC regional initiative on tourism has combined one of the country's national parks with those of South Africa and Zimbabwe to form the Great Limpopo Transfrontier Park. This park that is jointly owned by the three countries is aimed at international adventure and safari tourism traffic. This presents opportunities for inbound tourism for the three countries.

Although there are a number of registered airlines within Mozambique, the state owned LAM Mozambique(TM), has dominated the provision of air service connections between Mozambique and the other SADC member states. Schlumberger (2010) suggests Mozambique had three carriers that were registered for commercial air transport in 2007. With the exception of one private airline TTA Airlink that featured for a brief period in 2010, no other airline has competed with LAM on the intra-SADC market.

7.2.9 Namibia

Unlike most of the member states, Namibia was a UN mandate colony supervised by apartheid South Africa. The country gained its independence in 1990. The Namibian economy is still hinged to South Africa and the country depends mainly on minerals. The country is one of SADC's member states with high GNI per capita. The latest available World Bank statistics reflects that Namibia posted a 50 per cent and 114 per cent growth rate in both real GDP and GNI (PPP). Peace and stability have drawn international tourists to Namibia with spill over effects into neighbouring countries. The country offers businesses within the region market expansion opportunities as the standards of living within Namibia improve.

Air transport in Namibia has been dominated by the state owned Air Namibia. Although the JP fleet database discloses a few airlines registered to offer commercial services by the Namibian authorities, these seem to have been limited to domestic and charter services.

7.2.10 Seychelles

Seychelles is a small island nation that has the highest GNI per capita in SADC. The country's economy is largely dependent on tourism. The country, which joined SADC in 1997, pulled out in 2004 then re-joined in 2006. The reasons the country gave for leaving SADC in 1997, was the burdensome membership subscriptions that the country believed were not consistent with benefits they were getting as members. On seeking re-admission, Seychelles, (according to SADC), cited the importance the regional body played in promoting Seychelles' interests in the international economy. Because of its distant geographical location and small size of population, the country does not generate much outbound tourism traffic.

The island only has one state owned airline, Air Seychelles and it has served the intra-SADC network consistently over the period under review.

7.2.11 South Africa

Pirie (2006) notes that the end of apartheid in South Africa ushered in a new era of peace and stability in the region as it brought to an end the destabilisation tendencies of the then apartheid government. South Africa's normalisation of both international and business relations generated significant official and leisure traffic for SADC region. Since the lifting of global sanctions on South African businesses, transport and sporting events; many multinational companies, international and regional organisations, and international airlines have returned to South Africa. This has brought investor confidence and increased business activities in South Africa with multiplier effects on the region. South Africa has also hosted major world sporting events that have generated official and tourist travel to and within the region.

Although the South African Government still plays a significant role in the airline industry, as it owns two airlines plying the intra-SADC market (South African Airways (SAA), South African Express Airways (XZ)), they have allowed private airlines to compete on the intra-SADC market. The country's competitive domestic market has prepared South African carriers for the intensity of rivalry on the regional market. For the period under review eight airlines have featured on the intra-SADC network. Apart from the two state owned carriers six privately owned airlines, Airlink (4Z), Comair (MN), Inter Air (D6), 1Time (T6) Federal Airlines (7V) and Nationwide Air (CE) have served the regional market. However Nationwide Air ceased operations in 2008.

7.2.12 Swaziland

Largely surrounded by South Africa and having a short border with Mozambique, Swaziland's economy, like that of Lesotho is heavily dependent on South Africa. Its potential to generate traffic is also overshadowed by South Africa. According to the World Bank statistics as at 2010, the country posted a 50 per cent growth rate in both real GDP and GNI (PPP) over the period under review.

As is the case with Lesotho, Swaziland's state owned airline ceased operations in May 1999. The country entered into a joint venture with Airlink South Africa to form Swaziland Airlink in which the Swaziland Government owns 60 per cent. They also allowed a private company Swazi Express Airways to serve on the intra-SADC network. However, Swazi Express Airways ceased operations in April 2008.

7.2.13 Tanzania

Tanzania is one of the poorest economies of the world with an economy dependant largely on agriculture. It is also classified as an HIPC. During the period under review Tanzania recorded significant growth in real GDP and GNI (PPP). The country posted a growth rate of 122 per cent and 182 per cent respectively for the two indicators.

Its large population offers business expansion opportunities for firms in the region. The country is an important tourist destination within the region as it is host to the highest mountain in Africa (Kilimanjaro) and major tourist attractions such as Zanzibar and world heritage national parks such as the famous Serengeti.

Although two Tanzanian airlines have featured on the intra-SADC network, Precision Air (PW) has not made significant inroads on the intra-SADC network. The state owned Air Tanzania has had its AOC temporarily withdrawn by regulatory authorities for operational deficiencies. By 2010 the national flag carrier had stopped operating regional scheduled commercial flights. The JP fleet database reflects a number of airlines have been registered to provide commercial air transport operations. Schlumberger (2010) suggests there were 4 carriers in Tanzania in 2007.

7.2.14 Zambia

Zambia has a lopsided economy dependent on copper and is one of the countries whose economy has suffered from fluctuating world mineral prices. Zambia which is also an HIPC posted an increase respectively of 100 per cent and 125 per cent in real GDP and GNI over the period under review. A SADC initiated regional tourism project, the Kavango-Zambezi Transfrontier Conservation Area, that combines some of the national parks of Zambia with those of Angola, Botswana, Namibia and Zimbabwe is set to enhance the competitiveness of tourism in the region. The country is also an important tourist destination in the region as it shares with Zimbabwe one of the seven natural wonders of the world, the Victoria Falls.

Zambia is one SADC country where liberalisation witnessed the entry of five private airlines that did not survive for a long period. As a result many of the registered airlines within Zambia have tended to focus on domestic and charter flights. For regional air service connections, the country has taken advantage of the provisions of the YD by granting fifth freedom traffic rights to other African airlines to serve those markets that would have been pursued by Zambian

carriers. Published literature reveals that the country has extended fifth freedom rights to Air Namibia, Air Zimbabwe, Ethiopian Airlines (ET) and Kenyan Airways (KQ)

7.2.15 Zimbabwe

Zimbabwe has significant tourism potential but was weighed down by political and macroeconomic instability over the period 1999 to 2008. As a result real GDP as at 2010 had shrunk by 43 per cent when compared to 1998. The country, according to the latest UNTWO statistics was one of the countries to receive over two million tourists in 2010. The country has both business location and tourism potential that could be beneficial to the region once macro-economic stability is restored.

The economic meltdown and drastic fall in discretionary income had negative knock-on effects on demand for air travel. It also pushed private airlines out of business and left the state owned Air Zimbabwe struggling to survive.

7.3 Factors underlying strategy failure

The varied specific conditions and political climates in each of the SADC member states suggest that the execution of the strategy should have taken account of the uniqueness of the region.

7.3.1 Roadmap for implementation of air transport liberalisation

The goal for civil aviation reforms in SADC is clearly stated as “the gradual liberalisation of intra-regional air transport market.” What is clear is the effective date when the provisions became fully binding but the date by which this dream would become a reality appears to have been left to anyone’s imagination. What one can deduce, from interviews with the SADC secretariat, ministry officials and the various discussions in conference proceedings is a situation where there is a desire that developments in air transport liberalisation are in harmony with the goal of a common market by 2015.

However documentary analysis of the recorded conference proceedings that have dealt with implementation issues reveal no deliberate attempts at a detailed calendar of events and actions necessary for the achievement of exchange of liberal traffic rights, designations of airlines and encouragement of private sector participation in airlines. As a result the implementation of air liberalisation strategy has been guided by loosely defined goals rather than a roadmap with specific, measureable, action based, realistic and time framed plans as is the case with ASEAN. There are no indicative dates by which member states should have complied with multiple designations of airlines and liberal exchange of traffic among other things.

Without commitment to any detailed plan of action, air transport liberalisation in SADC has remained uneven. Those member states that appreciate the benefits of air transport liberalisation to the regional economy and their nationals have moved faster whilst some member states have sought to protect their own airlines and assure them of market share at the expense of regional connectivity.

Given the disparities in economic resources, those states with more financial resources at their disposal have made better progress than those with smaller economies.

7.4 Structural issues pertaining to implementation of air transport liberalisation

The SADC Protocol on TCM recognised the need for structural changes for efficient execution of air transport liberalisation. The vision, as advocated by Article 9.2 (c) was that there was going to be phased and coordinated institutional and structural changes of airlines, at airports, air traffic and navigation services providers and regulatory authorities. There were expectations that airlines would be commercialised and equipped for competition. Airports, air traffic and navigation services providers were expected to be commercialised. Regulatory authorities were expected to get out of airline operations and focus on regulatory and oversight functions. Aeronautical

authorities were expected to delineate and clarify roles between civil aviation authorities and ministries responsible for air transport. Developing regionally owned airlines was also considered a viable option for dealing with the small market size of many member states. Above all SADC would promote and sustain fair competition between service providers. These institutional and structural changes that would have gone a long way in expediting regional air transport network efficiency have not been realised in full.

Whilst it is acknowledged that structural changes take time, particularly in countries that needed to create autonomous aviation authorities, a period of fourteen years (1998 to April 2011) is considered long enough a time to have realised most policy reform goals. As the focus of this study is the intra-SADC network and not airport infrastructure the next section discusses airlines and the competitiveness of the industry.

7.4.1 Structural changes at airlines

There is evidence to suggest that there were attempts at structural transformation of airlines, though this exercise still lags behind. Whilst countries like the DRC, Swaziland, Lesotho and Mauritius have allowed private sector participation in competition with their national flag carriers the rest of SADC airlines are still state owned. ICAO (2007) noted that many initial privatisation plans were deferred because of complexities, local circumstances or the economic conditions of the airlines concerned. In some instances privatisation has been reversed for “national interest.” The South African Government bought back the 20 per cent equity stake it had sold to SAirGroup (a Swiss company), when the partner got into financial difficulties. The Tanzanian Government reinstated their 49 per cent equity shareholding in Air Tanzania after South African Airways pulled out. The Air Botswana website states that privatisation plans were deferred because the successful bidder (though an airline from a SADC country) did not meet political expectations. Namibia, according to Air Transport Intelligence (2009), had no immediate plans to privatise their airline.

Morrell (2007) notes that the privatisation plans at Air Madagascar, which were supposed to have been completed by 1999, were suspended.

Continued state ownership of airlines impacted negatively on negotiations for traffic rights, ability of airlines to optimise their route networks as well as decision making on aircraft fleet renewal. Girma Wake, in interviews held with him in Addis Ababa, attributed the inertia on exchange of fifth freedom traffic rights and private sector participation on intra-regional routes to intense lobbying by incumbent state owned airlines. State owned airlines have a direct influence on the nature of traffic rights in their market as government representatives involved in bilateral negotiations sit on their boards.

Whilst regional routes have a lot of potential for providing feeder traffic for long-haul operations, many state owned airlines have no aircraft for those routes and hence the irregular services and abandonments on some of the regional routes. Informants attributed the failure by many airlines to recapitalise and reequip their businesses to insufficient resources in many of the state owned carriers. An assessment of the sizes of the majority of economies of SADC as measured by both GDP and GNI are too small to sustain the operations of state owned carriers. With nine member states posting GDP, PPP (constant 2005 international $) and GNI, PPP (current international $) of less than US$20 billion per year, subsidies to airlines would be a burden on the public purse.

7.4.2 Cross-border ownership in airlines

The region has not witnessed significant cross border airline ownership deals. For the dominant player on the intra-regional network, SAA, apart from the 49 per cent cross-border ownership deal with Air Tanzania in 2001 that eventually ended in 2006, no other venture has emerged. In their 2006 financial statements SAA reveals that they had invested US$20 million in Air Tanzania with the intention of building a hub in East Africa. They however disposed their stake in Air Tanzania because of economic and financial considerations.

Other South African airline companies that have been involved in cross-border business ventures have been successful in a few countries. South African Airlink made inroads in countries with no airlines (Lesotho and Swaziland). Elsewhere the deals collapsed (e.g. Zimbabwe Airlink (Flywell airlines). South African Airlink however operates as a franchisee of South African Airways and its financial performance is linked to SAA.

Informants indicated that the reason for the low levels of cross–border investment activities was a reflection of the mistrust that exists amongst airline executives in the region. They noted that whilst the established carriers would want to help weak carriers, many deals were being inhibited by the lack of airline co-operation prevailing in the SADC airline industry. They pointed out that it was easy to help new comers than weak and struggling airlines.

7.4.3 Private sector participation on the intra-regional network

The failure by many governments to exit or reduce their direct involvement in the provision of passenger and cargo air services has brought about difficulties in enforcing the principle of “equal treatment and the promotion of a level playing field” that many of them had enshrined in their competition regulations. Comair, the strongest airline operator in the private sector and one of the private airline listed on the Johannesburg stock exchange (JSE) have taken state-owned South African Airways to the competition authorities for infringements. They argue that the state-owned carrier has crowded out private sector participation by predatory conduct that has instigated several airline failures.

The South African Government owns three airlines through the Department of State Enterprise. These are South African Airways, South African Express and Mango. Mango is a low cost airline that was created to counter competition from low cost carriers on the domestic market. Mango only focuses on the domestic market with the other two serving the regional and international markets. Whilst the strategy mirrors the one employed by privately operated Singapore Airlines, South African Airways are still subsidised by the state. South Africa’s

Department of State Enterprises (2010), in their strategic plan for the period 2011-2014, reveal that they provided South African Airways a R1.6 billion going concern guarantee in 2008. The carrier in turn accounts for such guarantees as equity in their financial statements (South African Airways Annual Report, 2011)

Outside South Africa, the ability of private sector operators to participate on the intra-regional market has been inhibited by inadequate access to financing. Informants pointed out that the ability of the private sector in small economies to raise adequate resources for financing and operating capital and labour intensive ventures such as airlines is limited by their inability to provide collateral or financial guarantees for aircraft financing. They indicated that although Ethiopian Airlines made use of government guarantees, the airline has largely depended on her assets and proven track record of repaying debts.

Private airlines embark on routes for economic reasons. This is aptly summarised by 1Time, one of the private airlines in SADC. They state that they only render airline services on those routes where they can make a profit. There are many markets on the intra-SADC network that might be unattractive to private sector operators due to the fact that the communities on such markets might not afford economical air fares. Governments have a legitimate reason to subsidise regional air services connections for such routes.

Since 2008, SADC's liberalisation program was affected by the ongoing global recession in which the raising of capital or loans from international financial institutions has become very difficult. Most SADC nations' crediting rating is considered very low for lending purposes.

The remoteness of SADC from major airline industry suppliers places a premium on major inputs such as aircraft, fuel, insurance and aircraft spares. This in turn has ripple effects on business operating costs and air fares. The prohibitive costs of operating an airline in SADC tend to discourage new entrants of low cost airlines to the regional air transport market.

SADC is prone to macroeconomic and political instability a phenomenon known to have a negative impact on air travel demand, access to offshore financing and business costs. This places high barriers to entry for those private players with intentions of looking for offshore financing. Furthermore, the implementation of the air transport liberalisation strategy coincided with the adoption of indigenisation policies in a number of countries. The effect of the policy is to restrict equity ownership in airlines to a country's inhabitants. The negative impact of such policies is that they constraint foreign capital inflows that could encourage private players to venture into the airline industry.

7.4.4 Competitiveness of the regional airline industry

The intra-SADC air transport market has remained dominated by state owned airlines and this has presented high barriers to entry for small private players. The consequence of excessive state involvement in the airline industry has been the protective tendencies in exchange of traffic rights and the high barriers to entry for low cost airlines.

Although the setting of fares has been deregulated and there are provisions for multi-designation of airlines on some city-pair connections, buyers in the regional air transport market have no bargaining power as there is not much choice on airlines. Travelling on the network has not been made any easier and the study observes that high cost of air travel in SADC has remained unchanged as at April 2011

The examination of SADC's road and rail network reflected that these modes of transport are constrained by long distances and underdeveloped infrastructure. However, the fact that road transport accounts for the highest transportation between SADC member states suggest low price as one of the reasons why SADC nationals opt for that mode of travel.

There is no rivalry on a number of intra-SADC routes as market concentration ratios are high. Commercial arrangements such as the strategic alliance amongst South African Express Airways, South African Airlink and South

African Airways have the negative impact of weakening competition. The effect of the absence of competitive pressure on the intra-regional market is that SADC airlines have had no motivation to innovate and adapt their business models to the economic dictates of modern airline business.

7.5 Resource availability

Article 9.3 of the SADC Protocol on TCM recognises the need for competent airline management, human resources development in the civil aviation sector and the development of distinct roles for owners, boards and management of SADC airlines. Article 9.2 identifies the creation of an appropriate regional institutional mechanism to support capacity building within member states as a viable option.

The deficiencies in airline management skills and competence are manifested in the type of business models on the intra-SADC network. Financially weak and encumbered with an aged small fleet, a handful of SADC airlines should have withdrawn from long-haul international markets at the onset of reforms. Some should have refocused their business model and aligned them to their new business environment. This has not happened as many have continued to serve three markets (domestic, regional and long-haul).

The intra-SADC air transport network is characterised by many thin routes and running profitable operations on certain segments require smaller and fuel efficient aircraft. Fleet mix at many state owned carriers is skewed in favour of bigger aircraft that cannot offer daily flights on thin routes. Officials interviewed pointed out that certain routes have no airlines because the state owned carriers that were serving them have no appropriate aircraft or are struggling to survive. In addition management turnover even at dominant state owned carriers such as SAA has not made the situation any easier.

Resource constraints, according to Jonathan Majakwara, have inhibited the recruitment and retention of skilled personnel in the airline sectors of many SADC countries. The much lamented reason for shortages of experienced

airline staff in the region is the loss of personnel to Middle East carriers. Whilst Girma Wake admitted the negative impact of staff exodus on the restructuring exercise, he believes that in a competitive environment, an airline should be able to come up with innovative ways of retaining skilled personnel.

SADC is yet to create a single central authority for the oversight of the implementation of air transport liberalisation and enforcement of competition regulations. In the absence of such an institution, the responsibility for implementation and oversight has been left to SADC member states with the SADC Secretariat in an advisory capacity. Many regional decisions are therefore governed by consensus. There are SADC airlines that are able to provide services on routes with sufficient demand to justify direct connection either as one-stop or multi-stop legs. Such services are constrained by the national sovereignty clauses. In the absence of consensus on whether air transport is for the collective common good for SADC nationals, air service connections have remained disintegrated.

Interviews with officials within ministries of transport and civil aviation authorities reveal that some governments have not been able to appoint staff whose sole responsibilities are focused on air transport liberalisation. As a result tasks and accountabilities for the implementation of air transport liberalisation are scattered in various institutions that have a role in air transport.

7.6 Conclusion

Efficient execution of air transport restructuring in SADC required a strategy that took account of the unique conditions and political climate within member states. Three key things that could have addressed this would have been the:-

- Setting of a clear and realistic timetable for achievement of reform goals,
- Creation of relevant and appropriate structures with distinctive roles and responsibilities and
- Appointment of competent individuals to the strategic positions that are essential to the viability of SADC airline services.

The absence of a realistic detailed roadmap, an ill-defined programme of action and inadequate resources contributed to the failure to transform the air transport liberalisation into reality.

8 Chapter Eight: Ideal demand driven intra-SADC air transport network

8.1 Introduction

This chapter proposes an ideal demand driven air transport network that would reduce fragmentation of air service connections in SADC. The chapter draws its potential routes from the estimates of demand that were generated from the econometric model described in Chapter 6. Better practices identified in Chapter 5, the provisions of the restructuring strategy and the findings in chapter 7 are used to inform recommendations on how the new connections identified would be best served. It is hoped that the introduction of new routes in SADC would extend the air transport network and the effect would be the improvement in connectivity and accessibility enjoyed by passengers due to the speed and convenience of air travel relative to surface transport alternatives (Reynolds-Feighan and McLay, 2006).

The econometric model revealed that the intra-SADC network has two types of capital city-pair connections. There are those with sufficient demand to justify direct flights and those that are essential but cannot sustain profitable operations. One capital city connection that deserves mention is the one linking Kinshasa in the DRC to Luanda in Angola. Whilst the estimates obtained from the econometric model depicted a region that is characterised by thin routes, the exercise however yielded twenty-four new potential routes that could be added to the intra-SADC air transport network.

The city-pair connections that qualified are presented in Table 8-1 below. The study considers the city-pair connection between DRC and Angola critical for social interchange as the surface transport links between the two countries are under developed. It is for this reason that the city-pair, although the demand forecast is 97 air passengers per week, was included in the potential routes. This city-pair has had consistent services for the period 1998 to the year 2010. TAAG Angolan airlines suspended services on this route in 2011.

Table 8-1 Potential routes and weekly passenger estimates on city-pairs that had no direct air service connections as of April 2011

	City-pair	Predicted estimates
1	Antananarivo-Dar es Salaam	191
2	Antananarivo-Seychelles	137
3	Dar es Salaam-Harare	204
4	Dar es Salaam-Kinshasa	217
5	Dar es Salaam-Luanda	269
6	Dar es Salaam-Mauritius	310
7	Dar es Salaam-Windhoek	123
8	Gaborone-Maputo	180
9	Gaborone-Mauritius	120
10	Gaborone-Windhoek	212
11	Harare-Kinshasa	193
12	Harare-Maputo	304
13	Harare-Mauritius	187
14	Harare-Windhoek	127
15	Kinshasa-Luanda	97
16	Kinshasa-Lusaka	310
17	Lilongwe-Maputo	120
18	Luanda-Mauritius	217
19	Lusaka-Maputo	190
20	Lusaka-Mauritius	235
21	Lusaka-Windhoek	170
22	Manzini-Maputo	234
23	Maputo-Mauritius	237
24	Maputo-Windhoek	152

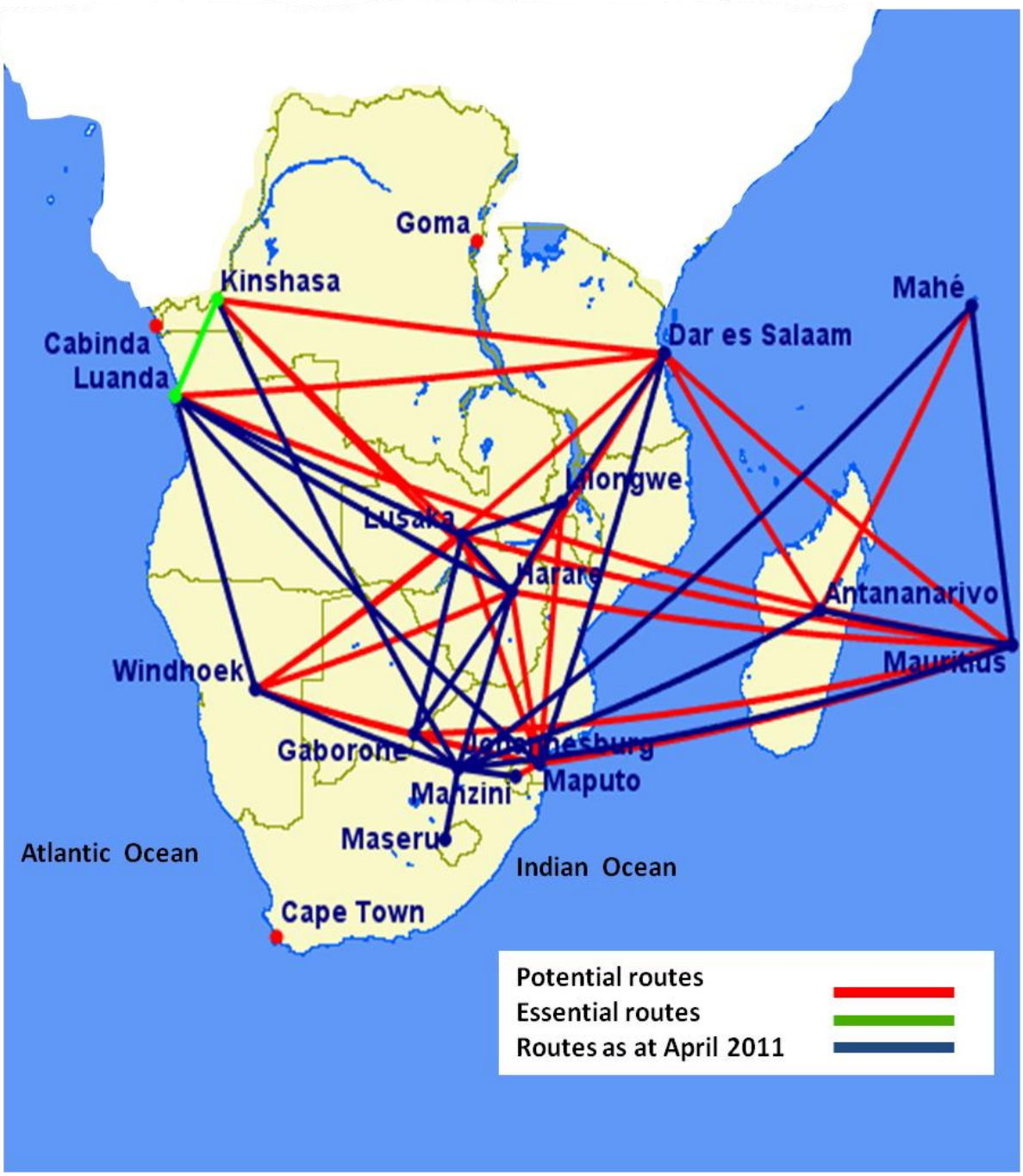
8.2 Proposals for a demand driven intra-SADC network

These proposals are made on the following assumptions;

a. SADC member states enjoy the rights to sovereignty over their air space as enshrined in the Chicago Convention of 1944

b. SADC is a signatory to a fully binding YD on the liberalisation of access to air transport markets in Africa
c. Basic airport infrastructure is not an issue in SADC at the moment (World Bank, 2010)
d. Subsidies on a city-pair can only be justified if there is no reliable surface transport

The mapped illustration of how a demand driven intra-SADC network would look like is presented in Figure 8-1 below. The new routes would help improve connectivity and accessibility within the SADC aviation network. This has the potential to provide better access and reachability of islands particularly Mauritius. It would reduce substantially the difficulties that are currently faced with SADC nationals and visitors to the region who need rapid and better regional air service connections to countries such as the DRC and Tanzania.



Source: Map created using OAG Flight schedules, econometric model estimates and Great Circle Mapper (copyright © Karl L. Swartz)

Figure 8-1 Proposals for an ideal demand driven intra-SADC air transport network

The extent to which these routes reduce the connectivity, accessibility and circuity gap on the intra-SADC network is addressed in the proceeding section.

8.3 Graph theoretic measures for the demand driven intra-SADC network

A computation of the graph theoretic measures of the proposed demand-driven intra-SADC network shows that the potential routes identified, if added to the network will improve the quality of the integration of the intra-SADC air service connections. The changes that the new city-pair connections would bring are presented in Table 8-2 below. Connectivity as measured by alpha and gamma would register improvements that are much higher than the pre-deregulation and April 2011 levels. The respective alpha and gamma levels of 42 and 50 per cent in place of low levels of 15 per cent and 27 per cent are an improvement towards a well-connected air transport network.

Table 8-2 Network improvements that can be achieved from new proposed routes

	Onset of reforms July 1998	Post liberalisation era April 2011	Proposed demand driven network
Graph Theoretic Measures			
Changes in Connectivity			
Alpha (α)	26 per cent	15 per cent	42 per cent
Beta (β)	2.53	1.87	3.47
Gamma (γ)	36 per cent	27 per cent	50 per cent
Theta (θ)	3,589 kms	2,821 kms	5,892 kms
Changes in Accessibility			
Shimbel Index	344 steps	364 steps	316 steps
L-Matrix	527,304 kms	571,420 kms	486,610 kms
Changes in Circuity			
Degree of Circuity	715,024 kms	1,112,929 kms	285,765 kms

Accessibility as measured by both the number of steps and the distance one needs to travel to reach any of the capital cities within SADC realises an improvement as the new route eliminates a number of steps and kilometres. The connectivity of such countries as the DRC and Zimbabwe reduces network circuity significantly. The net effect is the reduction in the cost of travel in terms of time and money.

8.4 Recommendations on how the new routes can be served

As mentioned in the introductory chapter, the reason for SADC's regional economic grouping is collaboration to expand markets. Whilst conceding that some SADC countries have small domestic markets, regional policy makers also acknowledge that each of the SADC countries has the potential to contribute significantly to the growth of passenger traffic in the region. This is because the ability to generate traffic covers both source markets (from where visitors originate) and destination markets, which are states attracting visitors. What the region needs as is stated in section 1.1.4 is an intra-regional air transport capable of connecting businesses to markets and enabling SADC nationals and visitors to the region to reach valued destinations as well as visit friends and relatives. The potential routes identified ought to be primarily between countries whose airlines are weak, struggling or have ceased operations altogether. However, such routes must be well linked and co-ordinated with the key South African airport system for regional cohesion and integration. The quality of service on these potential routes can only benefit from including rather than excluding the South African airline network. In partnership with the private sector, governments should invest in research to find innovative ways that ensure the existence of an efficient and reputable regional air service system from all capital cities.

8.4.1 Dar es Salaam

Dar es Salaam is of strategic importance in facilitating SADC passenger and business travel to East Africa. Although Air Tanzania is essential to provide competition on connections from Dar es Salaam it has faced many operational problems. Also, while Precisionair serves Dar es Salaam airport, it has not featured on the intra-regional network where it can make a great impact. Precisionair is backed by Kenyan Airways who own 49 per cent of the carrier. According to AFRAA (2011) Precisionair owns a fleet of 10 aircraft and serves 10 domestic and 3 regional routes. This study is of the opinion that Precisionair's aircraft resources might not be sufficient to adequately service the

identified routes. As such the Tanzanian authorities should grant fifth freedom traffic rights to other regional carriers from Africa and beyond. Developing these routes will certainly encourage more passenger traffic with beneficial spill over effects for small charter plane operators.

8.4.2 Kinshasa

Kinshasa has a pivotal role in linking SADC nations to Central and West Africa. The DRC has taken positive steps to encourage private sector participation in the airline industry. However, Hewa Bora (EO) has been the dominant player and it appears airline safety concerns have deterred the entry of new airlines on the scene. The DRC Government needs to deal with airline security issues head on. In addition, it should, like the Tanzanian Government, allow other African airlines to use fifth freedom traffic rights. In the long term both passengers and the DRC airline industry stand to benefit from such a liberal strategy. The country will be accessible and economically competitive more generally.

8.4.3 Gaborone

Gaborone is the seat of SADC and requires to be well connected on the SADC airline network. Although Air Botswana owns a fleet of 7 serving 3 domestic and 3 regional routes (AFRAA, 2011), the airline industry remains uncompetitive. This is despite having private sector players in the charter flight business. As a fast growing middle income country, it should liberalise access to the regional air transport market to more private sector stakeholders. The argument that Botswana has a small market that cannot accommodate more than one player does not appear valid as the country accounts for significant tourism flows within SADC.

8.4.4 Harare

Given its central geographical location in SADC, Harare contends as an ideal key hub of the region’s airline network system. In the long term, it should be

viewed and developed in this framework. With the demise of Zimbabwe Express and Zimbabwe Airlink, Air Zimbabwe has been the only operating player. However, as of April 2011, Air Zimbabwe was struggling to operate mainly due to financial difficulties. Except for charter services, new airlines offering scheduled service have not lasted long over the period under review as Zimbabwe has been affected by a severe economic meltdown and political instability. Consequently, long term solutions are needed to make the vital connections from Harare both viable and lasting to the benefit of the nation and SADC. The best option lies in opening up ownership of airlines to domestic and foreign investors (both regional and international) and giving fifth freedom traffic rights to African airlines. Whilst the likely impact as happened in Zambia is the cessation of operations by Air Zimbabwe, allowing competition in the airline industry helps the country access to international tourism and trade.

8.4.5 Luanda

Like Kinshasa, Luanda is an important gateway for travellers to and from Central and West Africa. It is also vital for trade for the booming Angolan economy fuelled by peace and the resource rich endowment; diamonds and petroleum. TAGG Angolan Airlines have dominated the intra-regional market. TAAG Angolan Airlines owns 11 aircraft that are spread over a network covering domestic, regional and long-haul routes. The airline's fleet replacement strategies seem to focus on long-haul routes instead of regional routes that have sparse demand. Given the economic growth the country has experienced over the period under review and its middle income status one or two strong regional airlines should be encouraged to serve the regional market.

8.4.6 Lilongwe

Like Harare, Lilongwe is strategically located to play a key part on the SADC airline network. AFRAA (2011) indicates that Air Malawi is a regional airline with a fleet compliment of 4 aircraft. Air Malawi is reported to be struggling in its operations and their small fleet would not allow them to expand their route

network. The options available would be to allow other SADC airlines to use fifth freedom traffic rights for the connection to Maputo.

8.4.7 Lusaka

Lusaka, Lilongwe and Harare are landlocked capital cities that would benefit immensely from a revamped SADC airline system. Zambia has opened its airline industry to private sector participation. Zambia has no airline of its own serving the regional market. Like the other SADC nations Zambia should continue to use fifth freedom traffic rights and to encourage foreign ownership (both regional and international) in their airline industry. Another option is to encourage foreign direct investment in airlines by lifting restrictions on foreign ownership in Zambia's airline industry.

8.4.8 Maputo

Maputo is in the same league as Dar es Salaam in its pivotal role to service East Africa. According to AFRAA (2011) LAM owned 7 aircraft that serve domestic and regional routes. Whilst it might be difficult for LAM to mobilise enough resources to serve the potential new city-pair connections, the country has the option to support business ventures of the nature of TTA and create an environment that is conducive for profitable operations. It should also grant fifth freedom traffic rights to SADC carriers and other African airlines. Given the size and potential of the Mozambican economy, the country could also encourage foreign investment in the airline industry.

8.4.9 Mauritius

Mauritius has played a big role in the SADC airline network. AFRAA (2011) notes that Air Mauritius owns 15 aircraft, with a route network spanning 4 regional and 10 long-haul city-pair connections. As the only player offering linkages with other SADC member states, Air Mauritius may be constrained by its commitments on long-haul routes. The option would be to encourage a small private player to serve the new regional routes or to allow SADC carriers and

other African airlines to serve them. Interaction with continental member states is critical for trade and tourism.

8.4.10 Manzini

Swaziland has opened its airline industry to private sector participation. As a small economy with a small domestic market, the connection with Mozambique can be best served by co-operation with a Mozambican carrier. Given the country's tourism potential, as it registers high tourism flows to the region (UNTWO, 2011), Swaziland could encourage significant foreign ownership in airlines in the country.

8.4.11 Antananarivo

According to AFRAA (2011), Air Madagascar has 12 aircraft at its disposal. Apart from an extensive domestic route network, the airline also serves regional and 3 long-haul city-pair connections. The options available for connecting Madagascar to Seychelles and Tanzania could be the encouragement of joint ventures with SADC carriers, liberal exchange of traffic rights with regional and other African airlines. Given its large population and foreign investment opportunities it offers, Madagascar could also ease foreign airline ownership restrictions to allow capital flows to its air transport market.

8.4.12 Seychelles

The dominant player in the airline industry in Seychelles, Air Seychelles, owns a fleet of 9 aircraft. Seychelles' airline network comprises the various islands making up the Seychelles as well as regional and long-haul city-pair connections. As a small country, adding one route to Madagascar would require encouraging small operators in each of the two countries.

8.4.13 Windhoek

Namibia is an important SADC member state within Southern Africa. Air Namibia has a fleet compliment of 12 aircraft for their domestic, regional and

long-haul operations. As a middle income country connections on the potential routes are possible if the country encourages private sector players in commuter and charter services to integrate forward into scheduled services. Namibia should follow similar policies and programmes recommended for the other regional airlines.

8.5 CONCLUSION

An ideal demand driven network would improve network connectivity and accessibility and reduce circuity. It is hoped that in addressing potential connections, member states would allow private sector participation and the entry of more airlines on the intra-SADC network. The networks of ASEAN and MERCUSOR benefited from the entry and participation of the private sector in the regional airline market. The effect is that an increase in competition has been known to lower fares and ultimately stimulate demand for air travel. Governments should only intervene when the private sector is considered weak or incapable of providing the service. Also, this chapter emphasises the importance of fifth freedom rights in many of the city-pairs. The YD recognises the importance of the liberal exchange of traffic rights particularly fifth freedom. It is important that SADC policy makers make use of them in order to improve network performance.

9 Chapter Nine: Conclusions and recommendations

9.1 Introduction

This chapter assesses the extent to which the study achieves its intended objectives. It also evaluates the contribution the study makes to a better understanding of the association between air transport liberalisation theory with the evidence and practice particularly in SADC. This work is the first in-depth study on the post-liberalisation intra-SADC network structure. The chapter discusses derived lessons and recommends measures that SADC should adopt for their air transport liberalisation strategy to deliver a regional air transport network that adequately addresses the needs of the region. The final part of the chapter considers some limitations of the research and discusses areas for potential further investigation.

9.2 Reflection

Academic investigation regarding the restructuring of air transport networks is an under-researched field especially in developing regions like Africa. SADC's fragmented airline network presented an opportunity to contribute new knowledge to the existing academic literature. What inspired this study was the intriguing phenomenon of disintegration of air service connections on a network undergoing a restructuring exercise. This was regardless of the well-documented empirical evidence showing positive results from liberalisation efforts in the U.S., EU, ASEAN and MERCOSUR. Secondly, in the absence of previous academic studies that specifically examine the challenges of airline liberalisation in the developing world, SADC's case study warranted the opportunity to test the applicability of liberalisation theory in real-life situations in Southern Africa. Thirdly, the problem besetting the intra-SADC network, a decade into a fully binding restructuring programme presented an opportunity to get a deeper understanding of the dynamics of liberalisation in developing countries at varying stages of economic development. The SADC case study has allowed a deeper and rigorous investigation of the reasons underlying fragmentation of airline services in the region. The use of the case study

approach in examining the post liberalisation intra-SADC airline network provided a good understanding of the challenges this method of enquiry poses in research projects.

The overall aim of this study was to investigate the modalities of implementing airline industry reforms and offer specific measures or possible solutions for SADC members for improving both policy, implementation strategies and intra-SADC air service connections either individually or collectively. To achieve this aim the objectives of the study were to;

- Benchmark the intra-SADC civil aviation network to ASEAN and MERCOSUR
- Establish the potential demand on intra-SADC city-pairs
- Examine factors accounting for the fragmentation of air service connections in the post-liberalisation era
- Identify the ideal demand driven intra-SADC air transport network
- Recommend measures that member states should take to improve intra-SADC air service connections

9.3 Achievements of the study

To a large extent, the study achieved the stated objectives. The study highlights that SADC made an important decision by embarking on civil aviation policy and institutional reforms as a way to create “a conducive environment for the development and provision of safe, reliable and affordable air transport services.” The study also shows that air transport in SADC is essential for;

- National and regional development, regional economic integration and the creation of an envisaged common market by 2015
- Increasing intra-regional trade and tourism flows
- Social and cultural interaction as well as integration
- The creation of the AEC by 2025
- Access to the global economy and destinations

The research findings show that the post liberalisation intra-SADC network changes as at April 2011 were the result of concerted efforts at reforms that had started in July 1998. The results achieved have been benchmarked to those of ASEAN and MERCOSUR. The networks of these two developing regions similarly undergoing airline industry restructuring have realised significant gains albeit operating in political and economic environments that approximate those existing in SADC. With the aid of the benchmarking exercise gaps in SADC's strategy implementation were spotted and better practices that the region can replicate were identified. The study established that SADC experienced transformational difficulties rather than change. The significant shortfalls identified in the implementation of SADC's liberalisation strategy related to the illiberal exchange of traffic rights, the failure to designate sufficient airlines and low levels of private sector participation.

An econometric model was developed to ascertain potential weekly passenger traffic volumes on city-pairs with no direct air service connections and identified a sizeable number of cities with sufficient demand to justify direct flights. Connecting those inter-city routes would reduce fragmentation as connectivity and accessibility improves and circuity reduces. Whilst thin city routes seem to characterise the intra-SADC network, there is also the possibility that the current restrictions have suppressed demand.

This research also establishes that the absence of a realistic detailed roadmap, an ill-defined programme of action and inadequate resources contributed to the problems faced by the intra-SADC network. The study observes that the region adopted a gradualist approach to liberalisation but failed to define the sequencing of the reforms to enable economically differentiated countries to proceed at the same pace. The study also finds that delays inherent in creating new institutions, unsuccessful attempts at privatising airlines, the paucity of competent civil aviation skills and inadequate financial resources constrained effective execution of liberalisation.

The study notes that disparity in economic wealth within the SADC community slowed down the pace of airline structural reforms. Airlines are both capital and

labour intensive and resource constraints in poor nations have led to the demise of a number of airlines. At the beginning of liberalisation many airlines were undercapitalised and balance sheets were littered with aged aircraft. With most annual national budgets below US$10 billion as measured by GNP (PPP), not all SADC member states can afford well financed carriers with modern fleets. Exacerbating this environment of inadequate investment is the high risk that emerging markets pose to international investors on one hand and government restrictive foreign ownership controls in airlines on the other.

Despite the constraints the region faces, the study established that the provisions of the YD and the supplementary clauses in the SADC Protocol on TCM, permits the region to design a demand-driven network. It allows member states to mobilise adequate resources from whatever source for the airline industry. The study used the potential routes identified by the econometric model and the best practice noted in the benchmarking exercise to propose an ideal network that addresses the needs of SADC. The proposed network improves network connectivity from the current poor levels, where a connectivity measure of 15 per cent suggests underdevelopment, to levels over 50 per cent.

This study identifies five key impediments to air transport liberalisation strategy execution:-

a. Political unwillingness to implement the whole spirit and letter of YD
b. Severe undercapitalisation of the airline industry in general
c. Policy imperfections and implementation bottlenecks over time
d. Although potential still exits, a number of city-pair connections between SADC capital cities are characterised by thin demand
e. The airline business in SADC presents both high risks and opportunities

9.4 Lessons learnt

As section 1.1.5 noted, air transport liberalisation is celebrated as the panacea to airline network efficiency. However the rewards of liberalisation appear not always to be fully achieved by all airlines in every developing region. What liberalisation does well is to set apart the weak and the strong airlines. The strong airlines thrive and grow while the weak ones become bankrupt and close shop. Liberalisation can have the disadvantage of perpetuating the divide between strong and weak airlines. What is important is the measures that governments put in place to ensure continuity in service provision when inefficient service providers go out of business.

Consultancy and academic studies on the implementation of liberalisation in Africa have always apportioned blame on government inaction and interference as the stumbling block to efficient networks. This case study shows that government interference is not always synonymous with airline failure. The only airlines on the intra-SADC network that have managed to meet the stringent requirements needed to qualify for membership of alliances (Star Alliance – South African Airways and Ethiopian Airlines) are 100 per cent state owned.. Both airlines have been able to capitalise and remain competitive in the global sphere because of government subsidy and support. Indeed, both ownership and management are critical factors to the viability of the airline industry.

When liberalising air transport in developing regions, policy makers need to assess the viability of city-pairs vis-à-vis the principle of self-sustainability espoused by air transport reforms. The countries that allowed their weak flag carriers to enter into liquidation have not benefitted much as the private sector has concentrated only on those routes where they can make a profit. The loser in such cases is the air traveller particularly those from regions without sufficient demand. Governments in poorer nations like Malawi, Mozambique and DRC need to find innovative ways of intervening in promoting airline service delivery. For example such states could encourage private sector initiatives and partnerships with larger and viable SADC airlines to promote service delivery.

This divergence between liberalisation theory and practice in Africa on the aspect of government involvement in the airline industry post liberalisation suggests that there is need to develop a framework that is based on the unique needs of a region that should certainly encourage joint private and public sector initiatives. Liberalisation programmes do not appear to have blue prints or templates of one size fits all; restructuring should be rooted in existing conditions of a particular area and based on rigorous policy and implementation research for best outcomes that also might incorporate relevant experiences from elsewhere in the world.

9.5 Major recommendations of the study

Various influences determine the shaping and success of regional civil aviation networks, chief among them is an airline industry that is highly competitive. The recommendations of this study address five key issues that affect the efficiency of the intra-SADC airline network. These relate to stimulation of air travel demand, mobilisation of airline finance for aircraft acquisition and operations, changing airline business models, phased implementation of the air transport liberalisation programme and dealing with very thin routes with insufficient demand to justify direct flights.

9.5.1 Stimulating intra-SADC air travel demand

Whilst there is debate on what comes first demand or air service connections, there is no argument that there is a relationship between the two. When air service connections are available there would be demand and vice versa. The air service connections should not only be efficient and safe, they should also be affordable. Member states should open regional routes to private sector participation to allow for competition which would in turn lower fares. With lower fares airlines would register higher demand for air travel. This has been the experience in AirAsia in ASEAN and Ryanair and EasyJet in Europe.

9.5.2 Mobilisation of finances for SADC airline industry

Radical changes are required if the majority of SADC member states are going to have viable airline industries. Member states have the alternative to widen the sources of finance for their airline industry by creating an environment that enables the private sector and foreign stakeholders to participate in the regional air transport market. Sovereignty clauses have to give way to authorisation of complete foreign ownership (100 per cent) in airlines. Countries like Chile have benefited from such policies of foreign partnership and participation. Encouraging significant foreign ownership in airlines would help bring in the much needed foreign currency and capital needed to strengthen the SADC airline industry and the network more generally. Kenyan Airways, one of the major players on the intra-SADC network is an example where foreign ownership by KLM brought in capital, management skills and an expanded route network. Although this contradicts the objectives of indigenisation policies highlighted in chapter 7, airlines are capital intensive and most SADC economies are not able to sustain profitable operations without outside help.

9.5.3 Changing business models

The choice SADC has at the moment is between isolation and connectivity. If the regional airline industry is to survive and serve the needs of the region then it is essential that SADC airlines review their business models and align them to their business environment. With limited resources in terms of fleet size and finances, carriers need to refocus their business models and limit their service to specific markets. One way of ensuring a competitive SADC airline industry with a global presence would be to render support to three airlines (perhaps South African Airways, TAG Angolan airlines and Air Mauritius) as the long-haul operators with the other regional carriers focusing on either domestic or regional routes and providing feeder service to the three carriers. These three carriers already have new and fuel efficient fleet for long-haul operations.

9.5.4 Phased implementation of air transport liberalisation

In a situation where fifteen countries are not uniformly developed (both socially and economically), the implementation of the air transport restructuring programme in SADC appears to have been highly ambitious. This is because those carriers with better financial resources, modern aircraft and skills had advantages over the weaker airlines. The best alternative for the fifteen member states is the identification of like-minded states ready to apply multilateral air service agreements (as is suggested by Article 13.2 paragraph 4 of the SADC Protocol on TCM). Once achieved this would then be replicated in phases in the rest of the region.

9.5.5 Essential air service on thin routes

One of SADC's strategic goals is to become a common market by 2015. Certain parts of the region such as the islands are only accessible by air. Given the fact SADC have an obligation to ensure that every national have equal access to air transport, the region should consider SADC Protocol on TCM's proposal for a regionally owned airline that would service those routes with very thin demand. There are both economic and social justifications for treating air services on such routes as a public good. The effect is the enhancement of regional development, social cohesion and equity. In addition subsidizing thin routes might help, in the short-term to stimulate demand and the possibility of these routes becoming profitable in the long term.

9.6 Limitations of the study and areas of further research

This research looks at a region that has not yet attained full potential in its air transport industry. Due to the paucity of studies analysing post liberalisation network structure in Africa, the study relied on literature from developed countries' indicators. As a result some developing country factors may have been inadvertently overlooked. The study is also examining work in progress.

The econometric model developed for SADC would have benefited from a combination of both qualitative and quantitative techniques if resources had

permitted. The best method would have been to combine market surveys with the gravity model to examine the potential demand for air transport. This certainly would have added value to literature on liberalisation in SADC. Resources permitting, this study considers market surveys on potential demand for intra-SADC air travel as an area for further research.

Airport infrastructure and aircraft technology were considered to be beyond the scope of this study. These two areas could form the basis of further research with regards to their contribution to the success or failure of air service connections in liberalisation strategies.

9.7 Conclusion

This study focuses on the restructuring efforts of SADC's regional air service market which is aimed at ensuring that the region fulfils its transportation requirements. In any regional economy, markets such as the financial services, manufacturing, retail, tourism and especially transport drive economic growth and general development. Governments have an obligation to ensure that markets play that role effectively. This study examines the restructuring agenda and exercise on the intra- SADC air transport market. Liberalisation is both the context and process within which the discussion and debates are examined. The core argument of the thesis is that while it was recognised that air transport restructuring was imperative, existing conditions in SADC from July 1998 to April 2011 greatly impeded the process.

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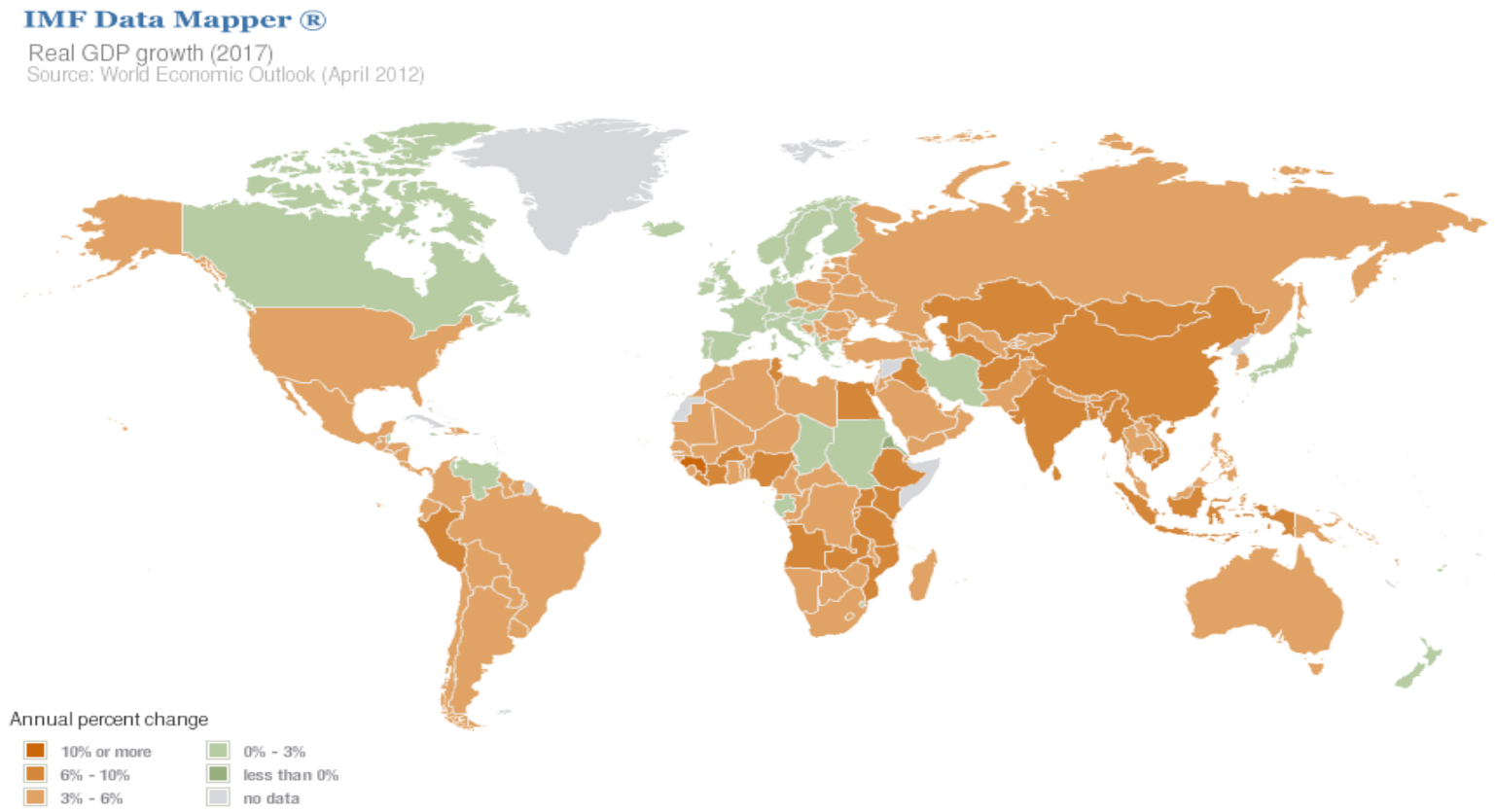
APPENDIX A



Source: http://www.imf.org/external/datamapper/index.php accessed 1st May 2012

APPENDIX B

INTRA-SADC AIRLINES AND CAPITAL CITY PAIRS SERVED BETWEEN 1998 AND 2011

	City-pair	Airlines	Country of origin	Presence of airline on route	
				1998	April 2011
1	DAR-HRE				
		Air Tanzania	Tanzania	Yes	No
		Air Zimbabwe	Zimbabwe	Yes	No
2	DAR-JNB				
		Comair	South Africa	No	Yes
		Precisionair	Tanzania	No	No
		South African Airways	South Africa	Yes	Yes
		Air Tanzania	Tanzania	Yes	No
		Alliance Air(SA/TC)	Joint venture	Yes	No
3	DAR-LLW				
		Air Malawi	Malawi	Yes	Yes
		Air Tanzania	Tanzania	Yes	No
		Zambia Skyways	Zambia	No	Defunct
		Zambezi Airlines	Zambia	No	Yes
4	DAR-LUN				
		Zambian Airways	Zambia	No	Defunct
		Air Tanzania	Tanzania	Yes	No
		Zambia Skyways	Zambia	No	Defunct
		Zambezi Airlines	Zambia	No	Yes
5	DAR-MPM				
		LAM Mozambique	Mozambique	No	Yes
6	DAR-MTS				
		Royal Swazi National Airways	Swaziland	Yes	No
		South African Airlink	South Africa	No	No
7	FIH-HRE				
		Air Zimbabwe	Zimbabwe	No	No
		Cameroon Airlines	Cameroon	No	Defunct
		Lignes Aeriennes Congolai	DRC	No	Defunct
8	FIH-JNB				
		Hewa Bora Airways	DRC	No	Yes
		South African Airways	South Africa	Yes	Yes
		Cameroon Airlines	Cameroon	No	Defunct
		Lignes Aeriennes Congolai	DRC	No	Defunct
9	FIH-LAD				
		TAAG Angolan Airlines	Angola	Yes	No
10	GBE-HRE				
		Air Botswana	Botswana	Yes	Yes
		Air Zimbabwe	Zimbabwe	No	No

	City-pair	Airlines	Country of origin	1998	April 2011
11	GBE-JNB				
		Air Botswana	Botswana	Yes	Yes
		Comair	South Africa	Yes	No
		South African Airways	South Africa	No	Yes
		South African Express	South Africa	Yes	Yes
12	GBE-LUN				
		Air Botswana	Botswana	Yes	Yes
		Zambian Express Airways	Zambia	Yes	Defunct
13	HRE-JNB				
		Comair	South Africa	Yes	Yes
		South African Airways	South Africa	Yes	Yes
		Air Zimbabwe	Zimbabwe	Yes	Yes
		Zimbabwe Express Airlines	Zimbabwe	Yes	Defunct
		South African Airlink	South Africa	No	Yes
		Majestic Air	South Africa	No	No
14	HRE-LAD				
		TAAG Angola	Angola	Yes	Yes
		Air Zimbabwe	Zimbabwe	No	No
15	HRE-LLW				
		Air Malawi	Malawi	Yes	Yes
		Air Zimbabwe	Zimbabwe	Yes	Yes
16	HRE-LUN				
		Ethiopian Airlines	Ethiopia	No	Yes
		Zambian Airways	Zambia	No	Defunct
		Air Zimbabwe	Zimbabwe	Yes	Yes
		Zambia Skyways	Zambia	No	Defunct
		Zambezi Airlines	Zambia	No	Yes
		Air Zambezi	Zimbabwe	No	Defunct
		Zimbabwe Express Airlines	Zimbabwe	No	Defunct
		Aero Zambia	Zambia	Yes	Defunct
17	HRE-MPM				
		Air Malawi	Malawi	Yes	No
		LAM Mozambique	Mozambique	Yes	No
		Air Zimbabwe	Zimbabwe	Yes	No
18	HRE-MRU				
		Air Mauritius	Mauritius	Yes	No
		Air Zimbabwe	Zimbabwe	Yes	No
19	HRE-MTS				
		Royal Swazi National Airways	Swaziland	Yes	No
20	HRE-WDH				
		Lufthansa German Airlines	German		Non-African
		Air Namibia	Namibia	No	No
21	JNB-LAD				
		TAAG Angolan Airlines	Angola	Yes	Yes
		South African Airways	South Africa	Yes	Yes

	City-pair	Airlines	Country of origin	1998	April 2011
22	JNB-LLW				
		Comair	South Africa	No	No
		Air Malawi	Malawi	Yes	Yes
		South African Airways	South Africa	Yes	Yes
23	JNB-LUN				
		Comair	South Africa	No	No
		Zambian Airways	Zambia	No	Defunct
		South African Airways	South Africa	Yes	Yes
		Air Namibia	Namibia	No	Yes
		Zambia Skyways	Zambia	No	Defunct
		Zambezi Airlines	Zambia	No	Yes
		Aero Zambia	Zambia	Yes	Defunct
		Nationwide Airlines Zambia	Zambia	No	Defunct
		South African Airlink	South Africa	No	Yes
24	JNB-MPM				
		South African Airways	South Africa	Yes	Yes
		LAM-Mozambican Airlines	Mozambique	Yes	Yes
		TTA	Joint Moz/Airlink	No	Yes
		South African Airlink	South Africa	No	Yes
25	JNB-MRU				
		Air Mauritius	Mauritius	Yes	Yes
		Comair	South Africa	No	Yes
		South African Airways	South Africa	Yes	Yes
26	JNB-MSU				
		Lesotho Airways	Lesotho	Yes	Defunct
		South African Airways	South Africa	Yes	No
		South African Airlink	South Africa	Yes	Yes
27	JNB-MTS				
		Comair	South Africa	Yes	No
		South Afican Airways	South Africa	No	No
		Royal Swazi National Airways	Swaziland	Yes	Defunct
		South African Airlink	South Africa	No	Yes
28	JNB-SEZ				
		Nationwide Air	South Africa	No	Defunct
		Air Seychelles	Seychelles	Yes	Yes
29	JNB-TNR				
		Inter Air	South Africa	Yes	No
		Air Madagascar	Madagascar	Yes	Yes
		South African Airlink	South Africa	No	Yes
30	JNB-WDH				
		Comair	South Africa	Yes	Yes
		South African Airways	South Africa	Yes	Yes
		Air namibia	Namibia	Yes	Yes
		South African Express	South Africa	No	Yes

	City-pair	Airlines	Country of origin	1998	April 2011
31	LAD-LUN				
		TAAG Angola Airlines	Angola	Yes	Yes
		Aero Zambia	Zambia	No	Defunct
32	LAD-MPM				
		LAM Mozambique	Mozambique	No	Yes
		TAP Air Portuga	Portugal		Non-African
33	LAD-WDH				
		TAAG Angola Airlines	Angola	No	Yes
		Air Nambia	Namibia	Yes	Yes
34	LLW-LUN				
		Kenya Airways	Kenya	No	Yes
		Zambian Express Airways	Zambia	Yes	Defunct
		Air Malawi	Malawi	Yes	Yes
		Zambian Airways	Zambia	No	Defunct
		Zambia Skyways	Zambia	No	Defunct
		Zambezi Airlines	Zambia	No	Yes
35	LUN-MTS				
		Royal Swazi National Airways	Swaziland	Yes	Defunct
36	LUN-WDH				
		Air Namibia	Namibia	Yes	No
37	MPM-MRU				
		Air Mauritius	Mauritius	Yes	No
38	MPM-MTS				
		Swazi Express Airways	Swaziland	No	Defunct
		Royal Swazi National Airways	Swaziland	Yes	Defunct
39	MRU-SEZ				
		Air Seychelles	Seychelles	Yes	Yes
		Air Mauritius	Mauritius	Yes	No
40	MRU-TNR				
		Air Madagascar	Madagascar	Yes	Yes
		Air Mauritius	Mauritius	Yes	Yes
41	SEZ-TNR				
		Air Madagascar	Madagascar	Yes	No

APPENDIX C

	Air passengers, 2010 (2)		Maritime passengers, 2009 (3)	
	(1 000)	(passengers per inhabitant)	(1 000)	(passengers per inhabitant)
EU-27	796 396	1.6	403 752	0.8
Belgium	22 691	2.1	751	0.1
Bulgaria	6 168	0.8	0	0.0
Czech Republic	12 242	1.2	-	-
Denmark	24 331	4.4	43 561	7.9
Germany	166 131	2.0	29 573	0.4
Estonia	1 381	1.0	9 140	6.8
Ireland	23 094	5.2	2 878	0.6
Greece	32 132	2.8	88 351	7.8
Spain	153 387	3.3	21 458	0.5
France	123 021	1.9	25 067	0.4
Italy	109 174	1.8	92 707	1.5
Cyprus	6 948	8.7	96	0.1
Latvia	4 656	2.1	591	0.3
Lithuania	2 283	0.7	205	0.1
Luxembourg	1 614	3.2	-	-
Hungary	8 175	0.8	-	-
Malta	3 294	7.9	7 799	18.9
Netherlands	48 617	2.9	1 632	0.1
Austria	23 532	2.8	-	-
Poland	18 383	0.5	2 481	0.1
Portugal	25 732	2.4	833	0.1
Romania	8 849	0.4	0	0.0
Slovenia	1 382	0.7	56	0.0
Slovakia	1 882	0.3	-	-
Finland	14 221	2.7	17 226	3.2
Sweden	26 647	2.9	31 066	3.4
United Kingdom	192 885	3.1	28 281	0.5
Iceland	2 036	6.4	433	1.4
Norway	29 517	6.1	5 728	1.2
Switzerland	37 616	4.8	-	-
Croatia	4 677	1.1	26 037	5.9
Turkey	:	:	1 386	0.0

(1) For air: aggregates exclude the double-counting impact of passengers flying between countries belonging to the same aggregate. For maritime: figures refer to the number of passengers 'handled in ports' (i.e. the sum of passengers embarked and then disembarked in ports); if both the port of embarkation and disembarkation report data to Eurostat, then these passengers are counted twice.
(2) Total passengers carried (arrivals and departures for national and international).
(3) Iceland, 2006.
Source: Eurostat (online data codes: ttr00012, tps00001 and mar_pa_aa)

APPENDIX D

		Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
			$POP_i * POP_j$	D^2_{ij}	$GNI_i * GNI_j$	$Trade_{ij}$	$Tourism_{ij}$	$HDI_i * HD$	$PSI_i * PS$	Dummy	Dummy	Dummy
	City Pair	Weekly Passenger Volumes	Passengers at Airports	Distance	GNI per capita	Trade US$ Millions	Tourism	HDI	PSI	Shared Border	Shared Language	Travel Restrictions
		Units	"000"	"000"	"000"	"000"	"000"	units	units			
1	Antananarivo-Johannesburg	489	9,876	4,601	2,407	166,778	13.61	0.27	0.01	0	1	1
2	Antananarivo-Mauritius	1,576	1,456	1,121	3,074	129,804	23.88	0.30	0.26	0	1	1
3	Dar es Salaam-Harare	147	871	2,292	185	4,894	17.39	0.05	0.01	0	1	0
4	Dar es Salaam-Johannesburg	1,208	22,993	5,998	2,865	521,177	42.56	0.24	0.00	0	1	0
5	Dar es Salaam-Lilongwe	117	421	980	155	55,900	19.85	0.15	0.00	1	1	0
6	Dar es Salaam-Lusaka	644	910	2,298	495	68,547	108.29	0.15	0.00	1	1	0
7	Dar es salaam-Maputo	90	951	4,056	220	13,881	6.25	0.11	0.00	1	0	0
8	Gaborone-Harare	214	222	854	2,331	293,975	835.50	0.07	1.76	1	1	0
9	Gaborone-Johannesburg	3,883	5,855	77	36,099	4,103,020	1318.40	0.39	0.01	1	1	0
10	Gaborone-Lusaka	97	232	1,138	6,237	29,129	80.59	0.24	0.26	1	1	0
11	Harare-Johannesburg	4,205	9,890	941	2,120	1,985,738	2512.04	0.07	0.02	1	1	0
12	Harare-Lilongwe	168	181	276	115	82,731	185.38	0.04	0.01	0	1	0
13	Harare-Luanda	130	1,488	4,692	1,436	80	8.73	0.05	0.22	0	0	1
14	Harare-Lusaka	1,010	391	158	366	144,524	401.43	0.05	0.58	1	1	0
15	Harare-Maputo	87	409	815	163	88,223	1075.97	0.03	0.41	1	0	0
16	Johannesburg-Lilongwe	744	4,786	2,196	1,776	540,432	153.28	0.23	0.00	0	1	0
17	Johannesburg-Luanda	4,120	39,284	6,205	22,232	2,144,235	66.11	0.25	0.00	0	0	1
18	Johannesburg-Lusaka	4,340	10,334	1,450	5,673	1,910,736	250.19	0.24	0.00	0	1	0
19	Johannesburg-Manzini	880	1,616	99	13,637	192,100	2237.70	0.30	0.00	1	1	0
20	Johannesburg-Maputo	2,613	10,806	196	2,521	1,794,993	2652.00	0.17	0.00	1	0	0
21	Johannesburg-Maseru	803	694	132	6,131	60,766	2403.02	0.26	0.00	1	1	0
22	Johannesburg-Mauritius	2,844	38,490	9,400	41,944	401,448	90.25	0.43	0.00	0	1	0
23	Johannesburg-Seychelles	404	9,611	14,168	53,977	68,250	10.61	0.52	0.00	0	1	0
24	Johannesburg-Windhoek	4,380	11,010	1,414	23,665	4,682,788	550.67	0.38	0.01	1	1	0
25	Kinshasa-Johannesburg	617	10,865	7,812	974	640,567	32.97	0.25	0.05	0	0	1
26	Kinshasa-Luanda	711	1,634	308	660	120,000	0.89	0.09	0.42	1	0	1
27	Lilongwe-Lusaka	173	189	359	307	85,431	102.96	0.15	0.00	1	1	0
28	Luanda-Lusaka	119	1,555	3,218	3,841	1,303	0.60	0.15	0.03	1	0	1
29	Luanda-Maputo	291	1,626	7,751	1,707	9,941	1.55	0.11	0.03	0	1	1
30	Luanda-Windhoek	849	1,656	2,493	16,024	406,720	370.88	0.25	0.08	1	0	0
31	Lusaka-Windhoek	399	436	2,019	4,089	14,731	134.86	0.24	0.21	1	1	0
32	Mauritius-Seychelles	332	1,417	3,059	68,954	34,868	11.01	0.59	0.14	0	1	0

APPENDIX E

Model A

Stepwise Regression: lnPass Traffic versus lnPOP, lnDistance, ...

```
  Alpha-to-Enter: 0.05  Alpha-to-Remove: 0.05

Response is lnPass Traffic on 10 predictors, with N = 32

Step              1        2        3
Constant     1.4309   0.1333   4.2902

lnTrade       0.422    0.298    0.182
T-Value        6.74     5.06     2.84
P-Value       0.000    0.000    0.008

lnPOP                  0.360    0.562
T-Value                 4.12     5.55
P-Value                0.000    0.000

lnDistance                      -0.62
T-Value                         -3.06
P-Value                         0.005

S             0.824    0.666    0.586
R-Sq          60.26    74.93    81.22
R-Sq(adj)     58.93    73.20    79.21
Mallows Cp     38.2     15.8      7.3
PRESS       25.3090  16.0277  11.9947
R-Sq(pred)    50.61    68.72    76.59
```

Model B

Best Subsets Regression: lnPass Traffic versus lnPOP, lnDistance, ...

Response is lnPass Traffic

Vars	R-Sq	R-Sq(adj)	Mallows Cp	S	lnPOP	lnDistance	lnGNI	lnTrade	lnTourism	lnHDI	lnPSI	lnBorder	lnLang	lnRestriction
1	60.3	58.9	38.2	0.82390				X						
1	52.8	51.2	50.6	0.89777	X									
2	75.8	74.2	14.3	0.65360	X	X								
2	74.9	73.2	15.8	0.66561	X			X						
3	81.2	79.2	7.3	0.58618	X	X		X						
3	79.3	77.1	10.4	0.61489	X	X							X	
4	83.2	80.7	6.0	0.56488	X	X					X		X	
4	83.1	80.6	6.2	0.56652	X	X		X			X			
5	86.2	83.6	3.0	0.52137	X	X		X			X		X	
5	84.8	81.9	5.3	0.54690	X	X			X		X		X	
6	86.5	83.2	4.5	0.52628	X	X		X	X		X		X	
6	86.5	83.2	4.5	0.52673	X	X	X	X			X		X	
7	86.9	83.0	5.9	0.52934	X	X		X	X		X		X	X
7	86.7	82.8	6.2	0.53344	X	X	X	X	X		X		X	
8	87.2	82.8	7.3	0.53391	X	X		X	X		X	X	X	X
8	87.2	82.7	7.4	0.53501	X	X	X	X	X		X		X	X
9	87.4	82.2	9.0	0.54213	X	X	X	X	X		X	X	X	X
9	87.3	82.1	9.1	0.54388	X	X		X	X	X	X	X	X	X
10	87.4	81.4	11.0	0.55474	X	X	X	X	X	X	X	X	X	X

APPENDIX F

Estimation for model A

Regression Analysis: lnPass Traffic versus lnPOP, lnDistance, lnTrade

The regression equation is

lnPass Traffic = 2.16 + 0.562 lnPOP - 0.308 lnDistance + 0.182 lnTrade

Predictor	Coef	SE Coef	T	P	VIF
Constant	2.1650	0.8929	2.42	0.022	
lnPOP	0.5621	0.1014	5.55	0.000	2.350
lnDistance	-0.3077	0.1004	-3.06	0.005	1.846
lnTrade	0.18197	0.06412	2.84	0.008	2.076

S = 0.586178 R-Sq = 81.2% R-Sq(adj) = 79.2%

PRESS = 11.9947 R-Sq(pred) = 76.59%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	41.622	13.874	40.38	0.000
Residual Error	28	9.621	0.344		
Total	31	51.242			

Source	DF	Seq SS
lnPOP	1	27.063
lnDistance	1	11.791
lnTrade	1	2.768

Obs	lnPOP	lnPass Traffic	Fit	SE Fit	Residual	St Resid	
1	9.2	6.192	6.929	0.156	-0.736	-1.30	
2	7.3	7.363	6.241	0.108	1.122	1.95	
3	6.8	4.990	5.136	0.177	-0.145	-0.26	
4	10.0	7.097	7.529	0.196	-0.433	-0.78	
5	6.0	4.762	5.432	0.155	-0.670	-1.19	
6	6.8	6.468	5.640	0.145	0.828	1.46	
7	6.9	4.500	5.200	0.161	-0.700	-1.24	
8	5.4	5.366	5.416	0.262	-0.050	-0.10	
9	8.7	8.264	8.475	0.293	-0.210	-0.41	
10	5.4	4.575	4.931	0.193	-0.357	-0.64	
11	9.2	8.344	7.868	0.173	0.476	0.85	
12	5.2	5.124	5.420	0.207	-0.296	-0.54	
13	7.3	4.868	4.467	0.402	0.401	0.94	X
14	6.0	6.918	6.126	0.196	0.792	1.43	
15	6.0	4.466	5.556	0.163	-1.090	-1.93	
16	8.5	6.612	6.963	0.136	-0.351	-0.62	
17	10.6	8.324	8.077	0.233	0.246	0.46	
18	9.2	8.376	7.753	0.169	0.623	1.11	
19	7.4	6.780	7.117	0.254	-0.337	-0.64	
20	9.3	7.868	8.382	0.263	-0.514	-0.98	
21	6.5	6.688	6.344	0.226	0.344	0.64	
22	10.6	7.953	7.633	0.230	0.320	0.59	
23	9.2	6.001	6.405	0.204	-0.403	-0.73	
24	9.3	8.385	7.960	0.199	0.425	0.77	
25	9.3	6.425	7.064	0.200	-0.639	-1.16	
26	7.4	6.567	6.689	0.170	-0.123	-0.22	
27	5.2	5.153	5.369	0.204	-0.216	-0.39	
28	7.3	4.779	5.116	0.255	-0.337	-0.64	
29	7.4	5.673	5.241	0.185	0.433	0.78	
30	7.4	6.744	6.276	0.176	0.468	0.84	
31	6.1	5.989	4.986	0.166	1.003	1.78	
32	7.3	5.805	5.678	0.131	0.127	0.22	

X denotes an observation whose X value gives it large leverage.

Estimation of model B

Regression Analysis: lnPass Traffic versus lnPOP, lnDistance, ...

```
The regression equation is
lnPass Traffic = 2.11 + 0.675 lnPOP - 0.356 lnDistance + 0.141 lnTrade
                 + 0.0797 lnPSI + 0.543 lnLang

Predictor       Coef  SE Coef      T      P    VIF
Constant      2.1113   0.8018   2.63  0.014
lnPOP        0.67462  0.09734   6.93  0.000  2.739
lnDistance  -0.35617  0.09079  -3.92  0.001  1.909
lnTrade      0.14144  0.05927   2.39  0.025  2.242
lnPSI        0.07967  0.03222   2.47  0.020  1.208
lnLang        0.5430   0.2240   2.42  0.023  1.194

S = 0.521366   R-Sq = 86.2%   R-Sq(adj) = 83.6%

PRESS = 10.3115   R-Sq(pred) = 79.88%

Analysis of Variance

Source          DF       SS      MS      F      P
Regression       5  44.1751  8.8350  32.50  0.000
Residual Error  26   7.0674  0.2718
Total           31  51.2425

Source      DF   Seq SS
lnPOP        1  27.0626
lnDistance   1  11.7912
lnTrade      1   2.7677
lnPSI        1   0.9555
lnLang       1   1.5980

             lnPass
Obs  lnPOP  Traffic     Fit  SE Fit  Residual  St Resid
  1    9.2  6.1924  7.1786  0.1664   -0.9862     -2.00
  2    7.3  7.3626  6.6245  0.1599    0.7381      1.49
  3    6.8  4.9904  5.2734  0.1802   -0.2830     -0.58
  4   10.0  7.0967  7.3930  0.2240   -0.2963     -0.63
  5    6.0  4.7622  4.9279  0.2739   -0.1657     -0.37
  6    6.8  6.4677  5.5225  0.1605    0.9452      1.91
  7    6.9  4.4998  4.5784  0.2503   -0.0786     -0.17
  8    5.4  5.3660  5.7200  0.2632   -0.3540     -0.79
  9    8.7  8.2644  8.7504  0.2758   -0.4861     -1.10
 10    5.4  4.5747  5.1673  0.1882   -0.5925     -1.22
 11    9.2  8.3440  8.1758  0.1836    0.1682      0.34
 12    5.2  5.1240  5.3690  0.1892   -0.2450     -0.50
 13    7.3  4.8675  4.5256  0.3682    0.3419      0.93
 14    6.0  6.9177  6.5163  0.2222    0.4014      0.85
 15    6.0  4.4659  5.3209  0.2356   -0.8549     -1.84
 16    8.5  6.6120  6.6972  0.1965   -0.0851     -0.18
 17   10.6  8.3236  7.6709  0.2594    0.6527      1.44
 18    9.2  8.3756  7.8931  0.1604    0.4825      0.97
 19    7.4  6.7799  6.7464  0.3059    0.0335      0.08
 20    9.3  7.8683  8.0806  0.2778   -0.2124     -0.48
 21    6.5  6.6884  6.3623  0.2136    0.3261      0.69
 22   10.6  7.9530  7.9105  0.2294    0.0425      0.09
 23    9.2  6.0014  6.5855  0.2021   -0.5841     -1.22
 24    9.3  8.3848  8.1420  0.1868    0.2428      0.50
 25    9.3  6.4249  6.8356  0.2368   -0.4107     -0.88
 26    7.4  6.5667  6.6475  0.2338   -0.0808     -0.17
 27    5.2  5.1533  5.1563  0.2097   -0.0030     -0.01
 28    7.3  4.7791  4.9320  0.2463   -0.1528     -0.33
 29    7.4  5.6733  5.4766  0.1878    0.1968      0.40
 30    7.4  6.7441  5.9484  0.2399    0.7956      1.72
 31    6.1  5.9890  5.2748  0.1748    0.7141      1.45
 32    7.3  5.8051  6.0151  0.1604   -0.2100     -0.42
```

APPENDIX G

New data for model validation

	City-pair	Weekly Passenger Traffic
1	Antananarivo-Johannesburg	1,147
2	Antananarivo-Mauritius	1,738
3	Dar es Salaam-Harare	160
4	Dar es Salaam-Johannesburg	1,719
5	Dar es Salaam-Lilongwe	204
6	Dar es Salaam-Lusaka	252
7	Gaborone-Harare	177
8	Gaborone-Johannesburg	5,937
9	Harare-Johannesburg	8,957
10	Harare-Lilongwe	233
11	Harare-Lusaka	911
12	Johannesburg-Lilongwe	1,958
13	Johannesburg-Luanda	5,141
14	Johannesburg-Lusaka	5,492
15	Johannesburg-Manzini	1,316
16	Johannesburg-Maputo	4,433
17	Johannesburg-Maseru	1,037
18	Johannesburg-Mauritius	3,818
19	Johannesburg-Seychelles	624
20	Johannesburg-Windhoek	7,919
21	Kinshasa-Johannesburg	1,112
22	Kinshasa-Luanda	616
23	Lilongwe-Lusaka	456
24	Luanda-Windhoek	965
25	Mauritius-Seychelles	826

Regression Analysis: LnNew Traffic versus lnPOP, lnDistance, lnTrade

The regression equation is
LnNew Traffic = 1.39 + 0.526 lnPOP - 0.280 lnDistance + 0.281 lnTrade

Predictor	Coef	SE Coef	T	P	VIF
Constant	1.387	1.016	1.36	0.187	
lnPOP	0.5259	0.1085	4.85	0.000	3.277
lnDistance	-0.28011	0.09247	-3.03	0.006	1.991
lnTrade	0.28139	0.09210	3.06	0.006	2.382

S = 0.487017 R-Sq = 86.2% R-Sq(adj) = 84.3%

PRESS = 6.98962 R-Sq(pred) = 80.70%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	31.242	10.414	43.91	0.000
Residual Error	21	4.981	0.237		
Total	24	36.223			

Source	DF	Seq SS
lnPOP	1	21.374
lnDistance	1	7.654
lnTrade	1	2.214

Obs	lnPOP	LnNew Traffic	Fit	SE Fit	Residual	St Resid
1	9.2	7.0449	7.2452	0.1580	-0.2003	-0.43
2	7.3	7.4605	6.5631	0.1076	0.8974	1.89
3	6.8	5.0752	5.1702	0.2820	-0.0950	-0.24
4	10.0	7.4493	7.9360	0.1704	-0.4867	-1.07
5	6.0	5.3203	5.7118	0.1590	-0.3915	-0.85
6	6.8	5.5309	5.9353	0.1507	-0.4044	-0.87
7	5.4	5.1753	5.8798	0.2792	-0.7045	-1.77
8	8.7	8.6890	9.0161	0.2638	-0.3272	-0.80
9	9.2	9.1002	8.3875	0.1555	0.7127	1.54
10	5.2	5.4523	5.7338	0.1947	-0.2815	-0.63
11	6.0	6.8144	6.4521	0.1719	0.3623	0.80
12	8.5	7.5797	7.4022	0.1197	0.1775	0.38
13	10.6	8.5451	8.6062	0.1991	-0.0611	-0.14
14	9.2	8.6111	8.2787	0.1548	0.3324	0.72
15	7.4	7.1823	7.4076	0.2265	-0.2253	-0.52
16	9.3	8.3969	8.8448	0.2275	-0.4479	-1.04
17	6.5	6.9441	6.5585	0.2171	0.3856	0.88
18	10.6	8.2476	8.0077	0.2098	0.2399	0.55
19	9.2	6.4360	6.6644	0.2162	-0.2284	-0.52
20	9.3	8.9771	8.5713	0.2086	0.4057	0.92
21	9.3	7.0135	7.5258	0.1736	-0.5123	-1.13
22	7.4	6.4236	6.9639	0.1632	-0.5403	-1.18
23	5.2	6.1225	5.6920	0.1959	0.4305	0.97
24	7.4	6.8723	6.7286	0.1767	0.1438	0.32
25	7.3	6.7166	5.8978	0.1664	0.8188	1.79

APPENDIX H

Interview guide for SADC Study

1. Thank the respondent/s for accepting to be interviewed
2. Give name of interviewer and purpose of interview
3. Get the name of respondent and the nature of their responsibilities in their organisation
4. Inform respondent/s on the duration of the interview: 90 minutes maximum
5. Establish whether respondent is agreeable to audio taping the interview
6. Inform respondent on confidentiality of discussions and seek their consent to quote them verbatim
7. **The focus of Interview questions is to get insight into strategy failure**

The YD has been in place since July 1998:-

- How important is it to your work and what are your responsibilities in the implementation process?
- What aspects of this civil aviation reform strategy would you say have been progressive? Which aspects of the YD have proved difficult to implement and why?
- What is the agreed timeline for the completion of civil aviation reforms and is this agreement in writing?
- The standard BASAs in SADC comply with the requirements of the YD on airline designation and removal of restrictions on access to airports, what has been the major impediment to liberal exchange of traffic rights?
- Civil aviation reforms envisaged institutional changes at airports, airlines, air traffic control and civil aviation authorities. What challenges have you encountered in effecting these changes? How have you managed to overcome the challenges?
- In what way has the delay in appointing a regional competition authority stalled the implementation of the YD?
- What steps would you recommend for the speedier implementation of the YD?

8. Allow respondents to ask questions. Inform respondents on how the data gathered is going to be analysed and reported. Wind up interview and thank respondents for the time they have set aside for the interview.